ADIO, TELEVISION and HOBBIES

lume 23, Number 4 — July, 1961

WILL FM DIE ALTOGETHER?

ALTHOUGH, as I write, the last issue has been on sale for only a few days, readers have registered very positive reaction to the editorial under the title "FM Must Stay On The Air." In particular has there been support for the idea of retaining and expanding A.B.C. programs in the space 92-94 Mc.

Whether this proposition will get very far in the face of decisions already taken is another matter. One might suggest that "the wheels of officialdom grind exceeding small" and it will be fortunate indeed if the remains of thousands of FM tuners are not found in the debris.

In a recent statement for the Press, the Postmaster-General set out the reasons for the decis- to terminate the FM broadcasts. These include an alleged lack of 'est in FM broadcasting, the need for television channels in the VHF trum, the rapid expansion of fixed and mobile services and the fact the FM transmissions have been "experimental" only, using program :rial often limited by lines to 5 or 6 Kc.

This last amounts to a rather pathetic admission that, after all the s of providing technical services for the A.B.C., the P.M.G. Depart- t is still working to standards so low as to make FM not worthwhile. mention is made of the noise rejection characteristics of FM tuners of the fact that locally derived programs are of a standard high gh to have won a substantial spontaneous following.

The pressure on spectrum space is very real, of course, as are the ons why many of the services should be accommodated in the VHF trum. But it is also true that the hi-fi enthusiasts are real people! So are those who have turned to FM because noise renders the medium- AM channels unsatisfactory. No less real are the thousands of pments which they have purchased and which are now destined to me so much junk.

To be sure, mention has been made of possible FM expansion in UHF band. But how and when? With the hi-fi fraternity successdiven back to their disc and tape, with no equipment in existence, commercial broadcasters on limited budgets, who takes the initiative?

I fear that if and when the "off" switch is operated, as predicted, ll be a long time before someone else pushes the "on" button.

W. N. Williams

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Cover Picture:

Ever since the days of crude spark transmitters and coherers, a major role of radio (and, later, electronics) has been marine communication, navigation, and safety in general. And, with the possible exception of straightforward communication, nothing has been quite as spectacular as radar in making the world's shipping lanes safer than ever before. Our striking cover picture was taken on the bridge of the "British Queen" as Extra Chief Officer E. G. Freeman checks the ship's progress and surroundings on a radar screen.

(Picture by courtesy of BP Australia Ltd.)

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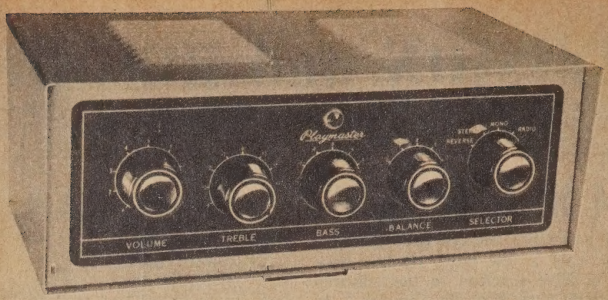

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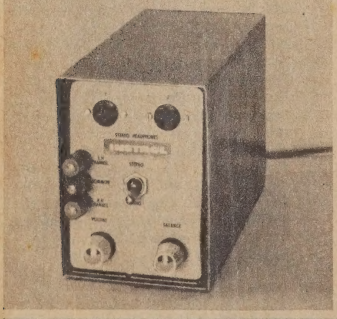

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STEREO HEADPHONE ADAPTER

(R, TV & H Jan., 1961)

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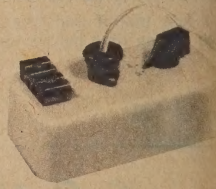

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e instruments, Audio Oscillator
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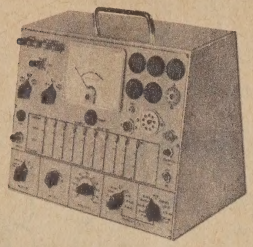
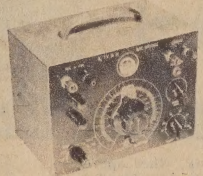
ansistor Tester ("R. TV & H."
gust, 1960), Bench Type Vacuum
be Voltmeter ("R. TV & H."
nuary, 1959), Six Band Service
cillator ("R. TV & H." September,
60), etc.

rite or call for full details.



The very latest in tester designs. The "R., TV and H." valve and transistor tester originally described in the January, 1961, issue.



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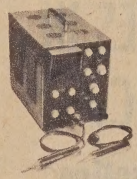

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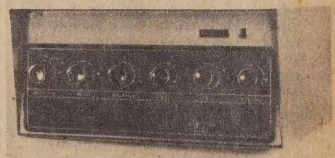
TWIN 10 WATT STEREO AMPLIFIER

("R. TV & H." MAY, 1961)



, new unit amplifier (output 10 watts per channel) incorporates every possible ure required in a stereo amplifier. Suitable for crystal and magnetic pick ups, an reproduce stereo tape recordings direct from tape recording heads. It in- es, twin radio tuner inputs, switching for mono, stereo and channel reverse, wide e of tone control, and spare switch position offers stereo for an extra source as TV or Movie Sound. Output provided for third speaker with provision monitoring on all three channels.

An amazing new unit yet most economical.

it of parts . . . . . £75/18/0 **Built and tested . . . £88/0/0**

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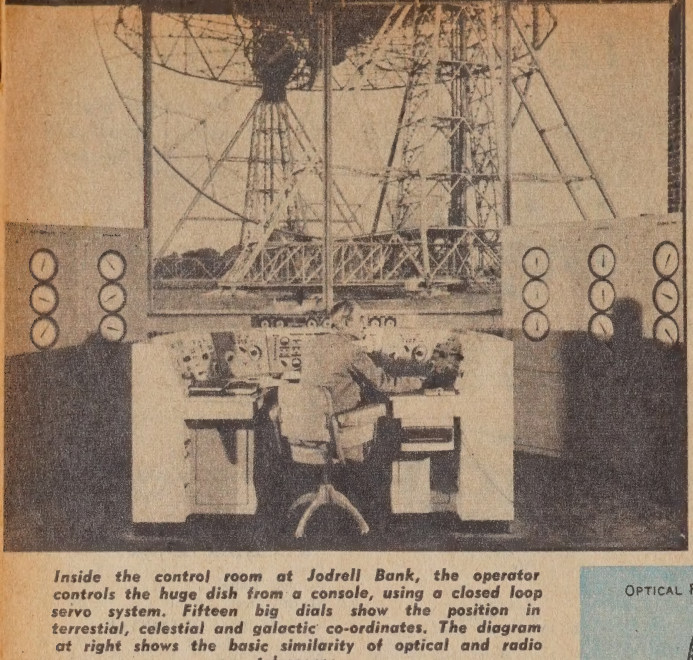
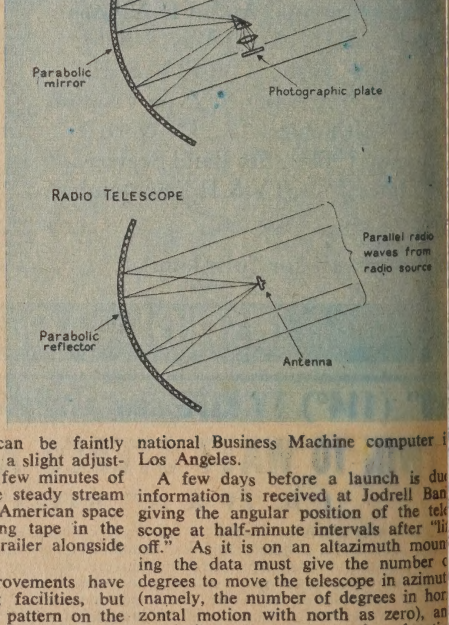


Inside the control room at Jodrell Bank, the operator controls the huge dish from a console, using a closed loop servo system. Fifteen big dials show the position in terrestial, celestial and galactic co-ordinates. The diagram at right shows the basic similarity of optical and radio telescopes.



TRACKING AND CONTROL OF SATELLITES IN DEEP SPACE

By R. G. Lascelles*

This article describes some of the work currently being carried out on Britain's giant radio telescope at Jodrell Bank. It is especially significant, because parallel work is to be carried out on the big radio telescope now nearing completion at Parkes, New South Wales.

POISED facing the south-western horizon, the huge dish of the Jodrell Bank radio telescope stands on edge like some gigantic car headlamp, a sombre grey filigree of girders cradling the back of the steel bowl. In a small laboratory, looking through glass panels into the control room, scientists are ready with tape and pen recorder.

Over the intercom, from the United States of America's mobile laboratory 200 yards (182 metres) away, come the latest messages from Cape Canaveral—"Three minutes from lift off" . . . "Seventy seconds . . . lift off."

It will be at least 10 minutes before the probe comes above the horizon. More messages . . . "First stage has fired correctly" . . . "Second stage ignited" . . . "burnt out" . . . "Third stage ignited."

The intercom is now receiving less attention as the signals from the latest U.S. Pioneer satellite can be faintly heard in the loudspeaker; a slight adjustment to the telescope, a few minutes of arc in elevation, and the steady stream of information from the American space probe is already punching tape in the U.S. Space Technology trailer alongside the telescope.

With experience, improvements have been made in receiving facilities, but fundamentally this is the pattern on the launching of a new space probe with which Jodrell Bank, near Manchester, England, is concerned as a tracking station.

From now on its function is threefold—to plot accurately the probe's angular position, particularly in the first few hours; to send command impulses out to the probe; to receive the data sent out by the probe.

As the distance increases steadily day by day so also does the importance of the 250ft radio telescope. As far away as the moon, approximately 250,000 miles, other aerial systems can still command a probe similar to Pioneer V, b already those same arrays are not r ceiving information at maximum rat assuming a five-watt transmitter on th probe.

At 10 million miles an 84ft parab loid using megawatts of power can sti interrogate the remote satellite but ca not detect any return response. Jodre Bank, however, will still receive info mation at 23 million miles.

If the probe's transmitter power is i creased to 150 watts, then the distanc over which communication can be estal lished will be close to 100 million mile

Tracking American space probes repr sents teamwork between United Stat and United Kingdom scientists. Amer can members of Space Technolog laboratories operate the command tran mitter, receive the signals detected b the telescope and are responsible fo their dispatch to Los Angeles, both b teletype and direct mail.

British personnel control the operatio of the telescope, measure the angula position of the probe in the sky and ar responsible for maintaining the track o the telescope as determined by the Inte national Business Machine computer i Los Angeles.

A few days before a launch is du information is received at Jodrell Ban giving the angular position of the tel scope at half-minute intervals after "li off." As it is on an altazimuth moun ing the data must give the number o degrees to move the telescope in azimut (namely, the number of degrees in hor zontal motion with north as zero), an a similar measurement in elevatio (namely, the tilt position of the bow with the zenith at 90 degrees).

After launch, slight corrections will b made to the orbital predictions by th Los Angeles computer, even so far as include a relativity adjustment at gre distances, so that at Jodrell Bank an other tracking stations positional data o increasing accuracy is received daily.

After the first day or so, the angula displacement across the sky of a dee space probe is similar to that of a sta If tracking is only done, say two o three times a day, for about half a

Special assistant to Professor Sir Bernard Lovell, at Jodrell Bank.

ach time, then within that short
t, the telescope can follow auto-
ly by taking out the rotation of
rth.

ng the early period after launch
e of movement of the telescope
frequently adjusted manually as
obe "climbs up" the western sky.
ances beyond 50,000 miles or so,
per motion of the probe is slight.
king can easily be accomplished
he astronomical co-ordinates of
scension and declination to con-
e telescope's position, which in ef-
mpensates for the earth's rotation
the instrument is always point-
the same point in the sky.

KING PROBLEMS

king, however, is not always quite
ightforward as it may seem. For
e, in the case of the recent Rus-
unching of a deep space probe
semi-elliptical orbit which will
t close to the planet Venus, many
complicate the issue.

transmitter on the "interplanetary
" to use the Soviet terminology,
mmanded by ground stations in
and details about the time in-
tion were not immediately made
le.

he frequency in use a very nar-
ncil beam, one-third of a degree
th, is produced by the telescope
increases the difficulty of the
g operation. Receiver stability,
dth and noise factor all contribute
quota to the complexity of this
n.

ertheless, it was felt that the
was not commanded during the
casion (February 27) when a meti-
search was made by the telescope
e hours, using the co-ordinates
ed by Moscow. This was con-
by an announcement by the Rus-
ews Agency Tass on the evening
rch 2, 1961.

als were received at Jodrell Bank
the morning of Friday, February
m a distance of 1,000,000 miles,
statement was made, for the
ts were unable to position the
n the main beam of the telescope
e of the short duration of the

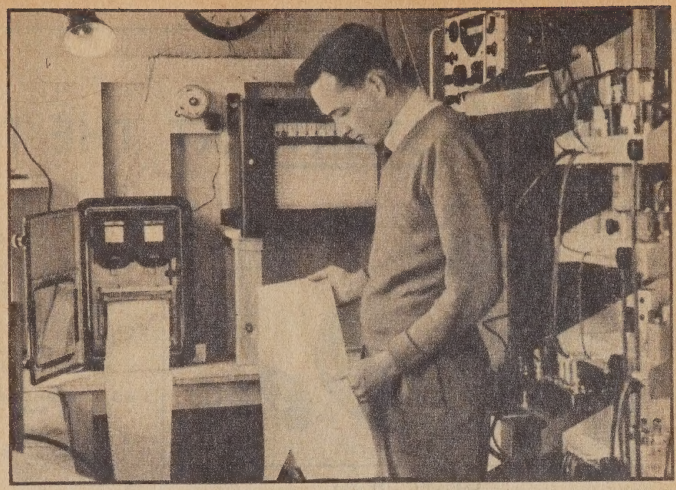
as, however, noted that the power
signals indicated by the side lobes
r in excess of what was expected,
is has since been explained by
raphs of the "interplanetary
" which show a parabolic antenna
at 922.8 Mc/s will have an ap-
ate gain of 150.

E PURPOSE

telescope at Jodrell Bank was,
r, primarily intended for funda-
astronomical research. Since
ed operation toward the end of
more than 13,000 hours of re-
have been completed, only a
fraction of that time, about five
at, having been used on tracking
s and space probes, both of
n and American origin.

research has covered a wide
of subjects, examining the earth's
ere, the solar system and inter-
ry space, the Milky Way, local
s, and cosmic catastrophes which
d thousands of millions of years

nany respects a radio telescope,
the 250-feet paraboloid at Jod-
nk, functions in a similar manner



Rob Rogers, a Canadian research student, examines results from a pen recorder at the giant radio telescope at Jodrell Bank, near Manchester, England. Miles of such records have to be analysed each year. Here, signals from the space probe Vanguard I are being used to help to find more details about the structure of the ionsphere.

to a reflecting optical telescope. This is not so surprising when it is remembered that radio waves are of a similar physical nature to light waves, but of a much longer wavelength, thereby necessitating a much bigger "mirror" in the radio telescope.

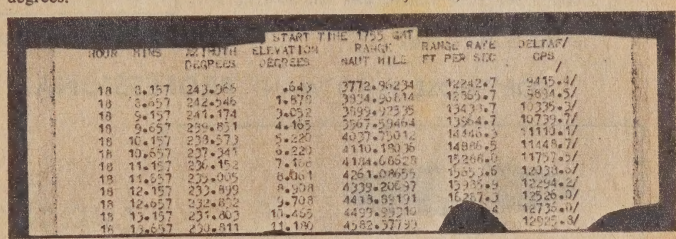
It is essentially a highly directional and highly sensitive antenna, receiving its signals from a tiny area of the sky.

In the case of the 250-feet radio telescope, the beam width to half power points is approximately one degree per metre of wavelength. Thus, when the telescope is operating at two metres (150 M/cs) the beam width will be about two degrees, while at 75 centimetres (400 Mc/s) the width will be reduced to 0.75 degrees.

When Lunik II hit the lunar surface, the beam width was more than ten degrees, the moon itself only occupying 0.5 degrees in the sky. In the case of Pioneer V, operating at a much higher frequency, the beam width was 0.75 degrees.

One important feature of the radio telescope not available to its optical counterpart is its ability to use radar. A pulse of energy is sent at regular intervals from the ground, reflected off a target, and the return echo either displayed on a cathode ray tube or recorded on tape.

Sometimes, as in the case of the echo from the planet Venus obtained in September, 1959, the return echo is below



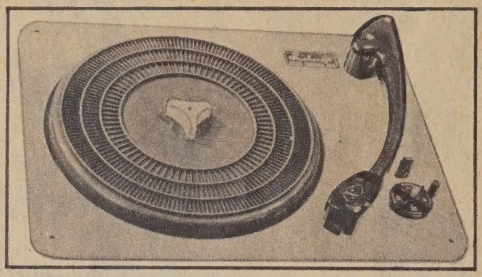
START TIME 1725 GMT

HOUR	MINS	AZIMUTH DEGREES	ELEVATION DEGREES	RANGE NAUT MILES	RANGE RATE FT PER SEC	DELTAF/ CPS
18	8.157	243.065	.649	3772.96234	12242.7	9415.4/
18	8.657	242.546	1.579	3934.20614	12365.7	9884.3/
18	9.157	241.174	3.652	3892.72235	12431.7	10235.3/
18	9.657	239.851	4.165	3967.20464	12564.7	10739.7/
18	10.157	238.573	5.220	4027.71041	12648.3	11113.1/
18	10.657	237.341	6.221	4110.19036	12806.5	11648.7/
18	11.157	236.152	7.170	4184.66528	12966.8	11797.3/
18	11.657	235.005	8.068	4261.08659	13053.6	12038.6/
18	12.157	233.899	8.908	4339.20697	13232.3	12294.2/
18	12.657	232.832	9.708	4413.89191	13267.3	12528.0/
18	13.157	231.803	10.465	4499.39210	[illegible]	12733.0/
18	13.657	230.811	11.180	4582.37793	[illegible]	12895.3/

An extract from tracking data at the radio telescope at Jodrell Bank. Just before and during the tracking of a probe into space information is received in this form from the National Aeronautics and Space Administration in the United States of America. The probe (launched in the U.S.) is 4,000 miles away when it comes over the Jodrell horizon.

The "Telebit" unit in the American space probes, Explorer VI and Pioneer V, encoded the information in digital form. This enabled receivers at ground tracking stations, set up by the U.S. Space Technology Laboratories, to punch the data in the above form. This was then fed into ordinary teleprinter machines and transmitted to Los Angles.

Hi-Fi STARTS AT THE TURNTABLE



LABCRAFT TYPE 573V

turntable 573V

- A unique, simple motor suspension and soft, flexible rim-belt drive, which completely isolates all vibration from the baseplate. Rumble less than 0.15 per cent.
- Complete with head, arm, switch, strobomat and built-in governor giving speed adjustment of plus minus 10 per cent on each 4 speeds 16, 33, 45, 78.
- Stylus pressure adjustable 5-10 gm. Featherweight arm-lowering lever.
- Interchangeable heads. Normally supplied with Ronette type 105 t/o stereo cartridge (supersedes type "stereo-OV.")

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professional type 605

- Fully shielded motor enables use of any low level magnetic pickup.
- Unique motor suspension and rim-belt drive **COMPLETELY ELIMINATES RUMBLE, BOTH VERTICAL AND HORIZONTAL COMPONENTS.**
- Attractively finished in satin grey and black.
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"All Balance" Pickup arm

- Ball bearings on every turning axis.
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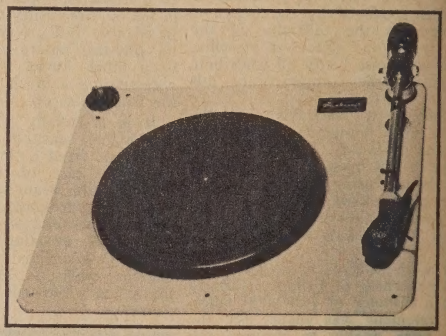

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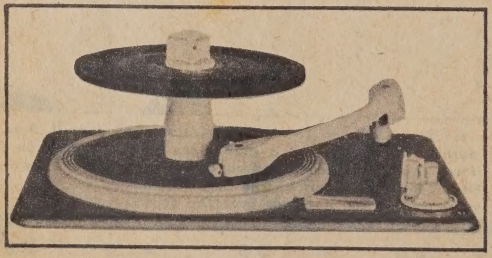

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- The 594V has the same basic construction as the 573V above and is modestly priced.
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ise level. Then it is necessary to me form of integration technique l the returning signal; this is ana- to a long exposure on the photo- c plate of the optical telescope.

pulse of energy takes five minutes the round trip Earth-Venus-Earth, when that planet is at its point of t approach, about 26,000,000

Due allowance must also be for the range alteration as Venus iches or recedes from Earth, and Doppler shift as the line of sight ration varies.

CAL EXPERIMENTS

) experiments from many carried n the Jodrell Bank telescope may ite its use as a passive receiver of emission from the depths of space. , the strength of the magnetic field e Milky Way has only been a t of speculation, varying from o 10^{-6} gauss. A measurement of eld by direct observation would be stimable value to the astronomers, his is precisely what is being at- d at Jodrell Bank.

as been known for a long time n electro-magnetic wave under the ice of a magnetic field splits into or more) component waves, one and one below the original wave- . This effect, known as the Zee- effect, can be shown as a labora- experiment in optics, but highly icated electronic circuitry is neces- o detect it at radio wavelengths

far, measurements made at Hydro- ne frequencies (21 cm/1420 Mc/s) not yet produced a positive result, can be deduced that the Galatic s less than 5×10^{-6} gauss.

second experiment, and one has occupied the majority of the ch time of the telescope, is direct- ncerned with the cosmic catastro- mentioned earlier. It has been n for almost ten years that one e most powerful radio sources to eived on Earth is, in fact, due to ision of two galaxies at a very re- distance, about 700,000,000 light away and now known as Cygnus

light year is the distance that light adio waves travel in one year at d of 186,000 miles in one second.)

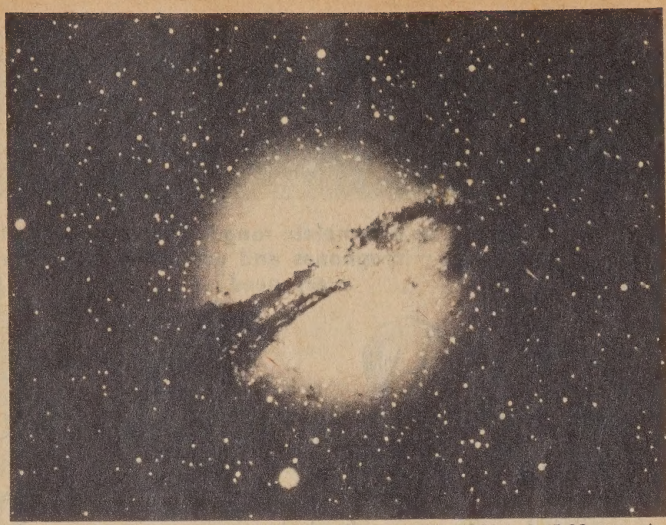
T, RADIO SOURCES

ng the Jodrell Bank telescope as rm of an interferometer, research d three years ago to measure the ar diameter of approximately 300 sources, some of which are thought similar to Cygnus A. Using a base line, latterly of 32,000 wave- s, about 20 sources have been es- d as being further away than that gnus A.

rtling support for this came in mid- when it was announced by Rudolf owski, of Mount Palomar Obser- y, using the 200-inch Hale tele- that one of these sources known cally either by its Cambridge cata- number of 3C295 or by its posi- n the sky—"1409" (right ascension) nearly 6,000 million light years t and receding from us at almost he speed of light.

s research may well provide data might give some indication as to rigin of the universe.

en we examine these remote



A catastrophe in space. This photograph, taken with a 200-inch (5.08 metres) optical telescope at Palomar Observatory, California, in the United States of America, shows two galaxies colliding in the constellation Centaurus. This phenomenon coincides with one of the sources of radio waves from space, which it is believed, are generated in the violent interaction between the gas and dust of the colliding nebulae.

sources, we are "looking back into time" —the light and the radio waves left 3C295 6,000 million years ago, more than half the age of the Gamow universe. Detailed examination of this epoch may therefore give us some idea of the galactic distribution and hence an inkling of the great unanswered cosmological question.

UNIQUE CHARACTERISTICS

It is precisely these two properties of the telescope, its ability to detect a weak signal at great distances, and its usefulness as a transmitting aerial of narrow beam width, coupled with its comparative ease of operation, that led to its use by the American authorities in the tracking of their deep space probes.

Any venture to Venus or Mars, using present satellite transmitting powers, will need a receiving aerial of this size if adequate information is to be received from the investigating probe.

Although a smaller aerial (say 84 feet) would be able to receive data from a probe near Venus at inferior conjunction, if that probe carried a 150 watt transmitter, about ten times as much information per second would be acquired by the 250-foot dish.

And as Venus passed this position of closest approach to the earth, it would rapidly go out of range of the smaller antenna.

The Southern Hemisphere will have a 210-foot telescope, at Parkes in New South Wales, Australia, by the end of 1961.

The United States at Sugar Grove has started work on a telescope of 600 feet, but this is not due for completion until 1964.

Without attempting to catalogue all the satellites and space probes logged at Jodrell Bank, the following may rank as the most noteworthy achievements:

Pioneer I (U.S.A., October, 58): Tracked to 70,700 miles when it returned to Earth.

Pioneer III (U.S.A., November, 58): Tracked to 63,580 miles when it returned to Earth.

Pioneer IV (U.S.A., March 59): Tracked to 400,000 miles; batteries failed, now in orbit around sun.

Explorer VI (U.S.A., August 59): In elliptical orbit around the Earth. Transmitter commanded from ground at regular intervals.

Pioneer V (U.S.A., March, 60): Tracked to 23,000,000 miles; transmitter commanded daily.

Sputnik I (U.S.S.R., October, 57): Check by radar on position of carrier rocket.

Sputnik II (U.S.S.R., November, 57): Check by radar on position of satellite after batteries had failed.

Lunik II (U.S.S.R., September, 59): Confirmation of impact with moon.

Lunik III (U.S.S.R., October 59): Confirmation of orbital position.

Interplanetary Station (U.S.S.R., February, 61); Signals received for short duration.

ROUTINE CHECKS

Frequently routine checks are made on other satellites, usually at the request of the National Aeronautics and Space Administration of the U.S.A., to establish an orbit.

The 250-foot telescope is not used for this purpose, since all that is required is the exact time of the closest approach of the satellite in question to Jodrell Bank.

Jodrell Bank is making an essential contribution to man's exploration of space, and when the unique characteristics of this telescope are required the station is happy to co-operate, particularly if such co-operation can be dovetailed into an overcrowded research program.

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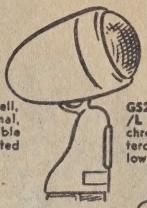
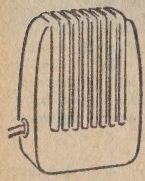
D88/F Filtercell, omnidirectional, with flexible chromium-plated suspension.

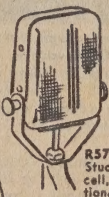


GS210 & GS210-/L Streamlined chrome finish, filtercell, high or low impedance.

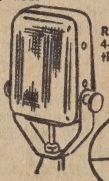
C53 Hand or stand, omnidirectional, black plastic housing and hand-grip.



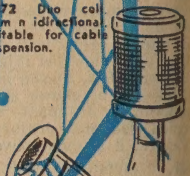
HM7 Hand or stand microphone, filtercell, robust die-cast housing, attractive finish.



44 Hand or desk mounting, counter-balanced base, ivory plastic housing.



R474 Studio type, 4-cell, omnidirectional

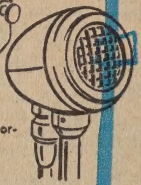


S472 Duo cell, omnidirectional, suitable for cable suspension.

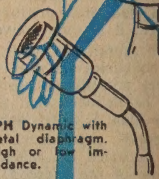
RFC5 & RFC5/L. Filtercell, semi-directional; high or low impedance.

RBH/T Ribbon velocity, available high or low impedance.

R372 & R372/L Studio type, duo cell, omnidirectional, high or low impedance.



B110 Plastic torpedo form.



DPH Dynamic with metal diaphragm. High or low impedance.

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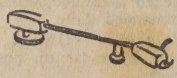

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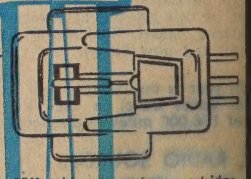
TX-88 wide range.

Turnover p/u cartridge TO-284/OV; TO-284/P; TO-284/T; TO-284/TX; TO-284/PX.

Stereo TO-OV



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XPERIMENT MOHOLE

Fire Down Below?

With the open sea, ship-deck recovery—joint by joint—of the longest pan of pipe ever thrust down into any ocean, the second act of an nparalleled scientific adventure finished recently—and work on the last act began.

UNDING more like science fiction than sober fact, the aim is to bore ole, under deep ocean, through the h's crust, to the co-called Moho ontinuity, where the hard rock tle of the earth is thought to begin. he thin, black hole — expected to be e four miles deep, under more than miles of water — would open the ed pages of the planet's own history, ributing to every branch of science. n ocean surface to bore-bottom, it ld be the deepest drill hole in the d.

s revolutionary as the project itself e drilling technique devised for it. A mond-tipped needle of pipe — a long, ry umbilicus — is let down from and rolled by an unanchored barge rid- the open sea. The barge is held ly against wind and tide by elec- ic methods.

ene of the science-drama's recent nd act was the open ocean 50 miles he lonely Baja, California coast of ico, equi-distant from Guadalupe id. Here, under 11,700 feet of ocean, drill's diamond jaws bit through more 500 feet of sediment and solid alt, a hard volcanic rock.

st one, a few weeks earlier, was a m-up" with 1,043 feet of drilling r 3,066 feet of water, off La Jolla. ongs there, extracted through the bit's eler mouth, attracted wide geologic at- on when a rock formation of Dolo- i was encountered where it wasn't posed to be!

N IN CHARGE

charge of the dramatic "inner od" exploration is a young geophysic- Gordon Lill, on loan from the Lock- Aircraft Corporation, a company tested in various wide-flung oceano- hic projects.

"he first two stages were experi- al," Lill said in a recent interview his Burbank office, "to test our ries, our equipment and ourselves. we'll prepare for the big drive."

his preparation, he said, may take al years.

"e'll put together everything we've ed, then start from scratch."

e final thrust, he said, will require gger drill barge, lighter drill pipe minium rather than steel, probably) improved equipment all around.

it was, the two experimental runs selves rang up impressive records: was the first deep drilling into the oceanic basin. (Commercial offshore rilling is through shallow water into ontinental shelf.)

was the deepest water ever pene- d by drill pipe.

was the first drilling from an un- ored ship.

aut buoy" cables outlining a block ean and topped by an electronic ship-positioning fence are at the heart of the imaginative new method, which is expected to open the oceans to commercial drilling.

On the barge, in a special compartment, a technician sat before a console. With a single joy stick control he blended together two blips on a glass screen — and held the ship steady over the long steel string spinning down through its keel.

Dubbed "the largest outboard in the world," the 260-feet drill ship, the Cuss I, was fixed on its site by four 200 horsepower diesel outboards, one at each corner. Propellers constantly turning, they responded with instant precision to the single control.

The two blips were funnelled electronic readings from a total of 10 radar and 10 sonar buoys forming the fence at the top of the block of ocean. The buoys were strung like giant beads on 10 stainless steel cables — 7/32in diameter — locked to the bottom by blocks of concrete.

Straining upward some 200 feet beneath the surface were the sonar-equipped "doughnuts," their buoyance exerting a lift of 3,200lb each. The radar buoys rode on top.

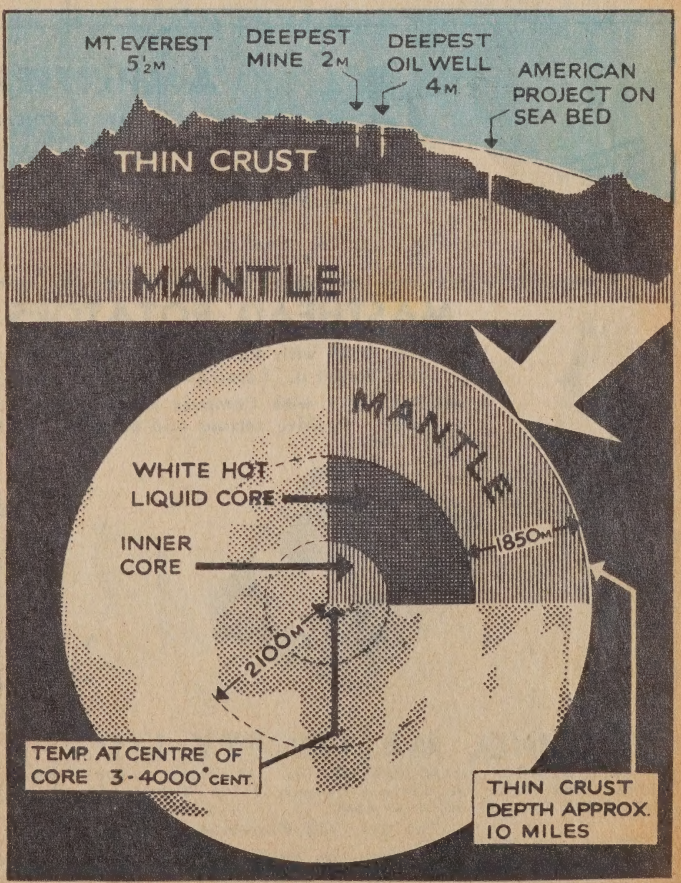
The cables limned an area one mile around and 2.3 miles deep. Dead centre through it was the rotating drill pipe, widely flexible in the middle but gripped and held straight at keel and ocean floor by massive drill shoes.

Attending the barge were two mother ships, the Spencer F. Baird and the Orca, floating laboratories staffed by scientists and supplied by the Scripps Institution, through the Navy Department.

Lill, the Lockheed scientist in charge, is chairman of AMSOC, a National Academy of Sciences committee. Official sponsor is the National Science Foundation. World-wide scientific interest was expressed through endorsement of the project by the International Union of Geodesy and Geophysics.

Tension and drama stood every watch on the Cuss I throughout the drilling. One error, one momentary failure and

(Continued on Page 87)



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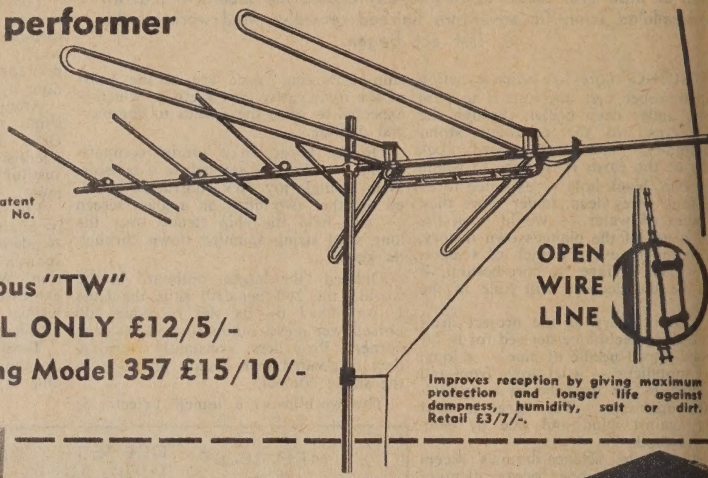

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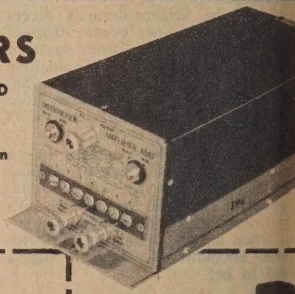

MASTHEAD ROTATORS

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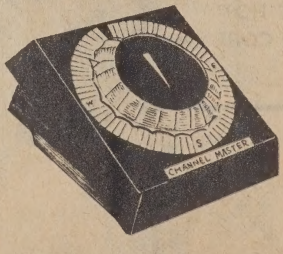
2. MODEL 9522 with Compass Rotator—Manually operated. Positive setting and stopping. Retail £33.



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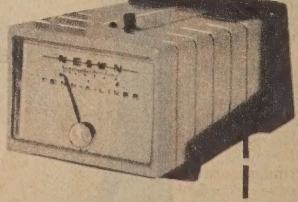

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EXTENSION COURSES BY RADIO

First University — Owned Station

"Radio University" is the name given to the University of New South Wales series of graduate and extension studies broadcast through their own radio station, VL2UV. The station, which broadcasts on a frequency of 1,750Kc and with a power of 300 watts, commenced operation in May this year and at present transmits two nights weekly commencing at 7.30 p.m.

The courses are designed for students who, for one on or another, find it difficult to attend the University who wish to take professional refresher or special courses. Present the courses are mainly in the fields of electrical neering and liberal arts, but it is proposed to introduce ses in Business Management, Accounting, and a variety ubjects designed to interest everyone from the leaving nt to the established businessman.

While it is possible for anyone with a suitably modified iver to listen in on the courses, it is necessary to have specially prepared lesson notes and diagrams in order to understand them. These notes are presented to the nt at enrolment and, in addition, he may purchase or for the duration of the course a special receiver tuned he frequency of the station.

The fees asked for the courses are reasonable, varying n 30/ to £3 per course and an additional 30/ if the hire receiver is required. The cost of each course is largely rmined by the amount of work involved in the prepara- of the lesson which accompany the course.

Two courses are in progress at the time of writing, the s on Wednesday nights at 7.30 being entitled "Theatre Drama," and consisting of three sections of 10 lectures ch section. The second is entitled "An Introduction To back Control," and runs to five lectures with extensive n notes.

A special course of study is being arranged as part summer school in January, 1962, for students who have one or more units of the radio extension course. De- of these arrangements will be published at a later date he university. Tapes of these lectures will be made able to people who live outside the reception area.

At present, with its low power and temporary aerial m, the station has a coverage of some 20 miles in a around Kensington, although reports have been re- d from as far afield as New Zealand. Ultimately the n will have a coverage of 100 miles from the University this being the official limit set by the P.M.G. Depart- for transmissions to students. While signals will likely eceived over a far greater distance than the 100-mile enrolment from students outside the area cannot be oted.

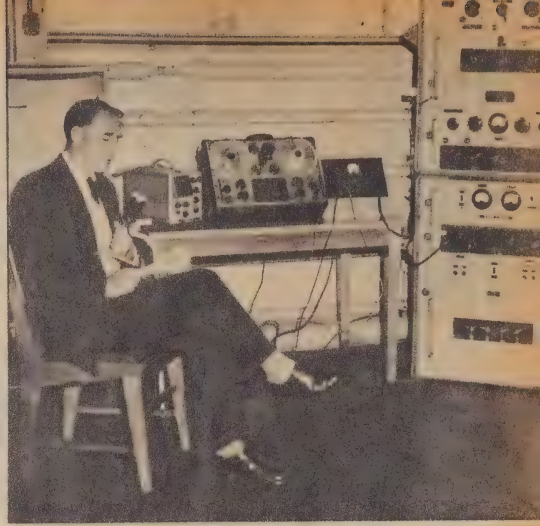
PRESENT INSTALLATION TEMPORARY

Present site of the transmitter, which is a converted war- R.A.A.F. AT14, is in the top floor of the electrical neering building. The aerial is a quarter-wavelength long, horizontal, part vertical, with matching to the trans- r being accomplished by means of a Pi section tuning work. A bandwidth of approximately 7Kc is occupied, to the limited audio characteristics of the AT14.

All transmissions are simultaneously tape-recorded and tapes stored for future courses or distribution to stu- outside the reception area. Audio equipment worth 00 is at present under order, and it is hoped to have service well before the end of the year. This equipment des two new high quality tape-recorders and suitable r units. This should make operation of the station far r for those concerned, as they will be able to pre- d lectures for later replay over the station.

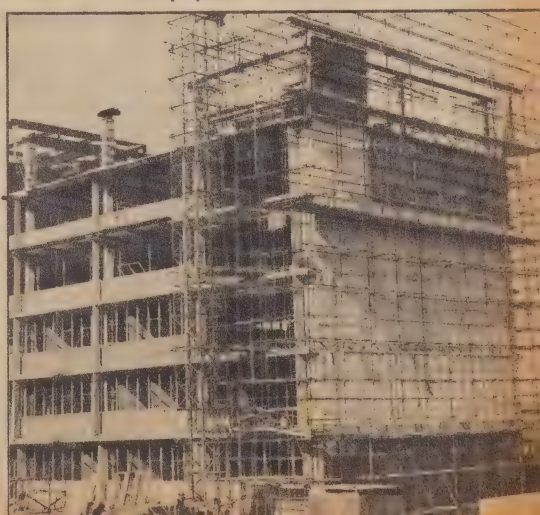
Tenders have been called for the construction of a one- watt transmitter, expected to cost around £12,000, to be led in the new electrical engineering building at present r construction. A special aerial tower 120 feet high will ected on the roof of this building to provide the neces- 100-mile coverage. It is anticipated that the station should be in operation from this building early in 1962 and, when completed, will have its own soundproof studios both for recording and transmitting.

It cannot be said that this is the first broadcast of its type in the Commonwealth. However, it is the first permanent installation of a transmitter fully-owned and controlled by a university and designed to transmit year-round courses to students on a permanent basis. The man responsible for the station and the presentation of the lectures is Associate Professor D. Broadbent, who is co-ordinator of post-graduate and extension studies at the Kensington division of the University of New South Wales.



Associate Professor Derek Broadbent is here shown at the microphone of the temporary station. At the extreme right is the 300 watt AT14 transmitter and alongside it the temporary mixer, tape recorder and monitor oscilloscope.

Still under construction but expected to be completed before the end of the year is the new electrical engineering building which will house the new one kilowatt transmitter, together with its two recording studios and control room. A 120 foot aerial will be erected on the roof to ensure adequate coverage within the proposed 100-mile radius.



"Don't burn it!" The lady is naturally concerned; too much carbon will ruin that delicate flavour. But carbon in the right place is one of our most valuable elements. Whether it's plastic or anaesthetics, petrol or wonder drugs, carbon will almost certainly form a vital part of it.

Organic Chemistry—A Story Of Carbon

Of all the elements on our planet, carbon must surely rank as one of the most valuable. The juggling of carbon atoms—organic chemistry—is one of the industrial chemist's most rewarding activities. It has given us thousands of new substances in the past few years and the future possibilities seem endless. Some think it may hold the clues to the origin of life itself.

By Calvin Walters

THIS branch of chemistry deals with all those compounds which contain atoms of carbon in their molecules. Inorganic chemistry deals with compounds which have no atoms of carbon in their molecules.

These carbon compounds are of vital significance to all the processes of living matter. Without them, life would be impossible.

One could say, of course, that without inorganic compounds life would also be impossible. However, when the enormous and endless possible combinations of carbon molecules — compared with the limited possible combinations of inorganic molecules — are taken into account the importance of the carbon atom becomes apparent.

The word "organic" to describe compounds containing carbon was derived from the fact that, at the time when the word was coined over a century ago, these compounds were to be obtained only from the bodies of plants or animals.

When we think of the word carbon in a hurry, we usually conjure up a picture of a piece of charcoal, the carbon rod from a dry cell battery, burnt toast, a piece of coal, soot from a locomotive, barbecued steak or sausages, and so on. This is carbon in the raw.

Now, if you think about it, you will realise that all these types of carbon are from plant or animal tissue. Similarly, the ash from burnt paper or rag and the smoke from burning rubber or oil, all contain carbon and all are vegetable or animal in origin. In fact, it is difficult to think of any way of obtaining carbon, except from vegetable or animal matter.

Carbon compounds can, of course, be made artificially in the laboratory, but in an entirely different manner to that devised by nature which, by the use of certain substances called "enzymes" can, at the temperature of the human body, or even lower, act upon carbon compounds to bring about an endless variety of chemical changes.

How the enzymes do this is still li understood, but we do know that particular enzyme, the green chlorop of plant leaves, converts a carbon c pound, namely the gas, carbon diox into the sugars, starch and cellul which is necessary to build up the pl

Some of the nutrient substances ne sary for plant growth is derived fr the ground, but it is the minute amo of carbon dioxide taken from the acted upon by chlorophyl in the p sence of sunlight, which sets off the p cesses of growth and the conversion one carbon compound into others sugar, starch and cellulose. To m sugar, starch or cellulose artifici would be a most costly process.

RELATED TO CARBON

The immense importance of car compounds in relation to life can be ther emphasised by remembering that the hormones of the body, and all proteins and vitamins, are connected some way with carbon compou Viruses, including some disease ge and bacteria, also are compounds of bon.

Carbon compounds are not confine living tissue, but are found in end variety in chemicals, dyes and fuels s as petroleum in all its forms.

What then are these carbon c pounds and what makes them so dif ent to inorganic compounds? To plain this, we will have to delve a into elementary chemistry, but not much. We will refresh our memo in matters of formulae.

We know that elements carbon, h hydrogen, uranium and so on, are m up of atoms which remain intact in chemical reaction (the exception b the radioactive elements). All the at of any element have the same weigh

Now a chemical compound is where atoms of different elements u in a certain ratio, so that when the at unite they provide their proportion the total weight of the molecule.

Water is an example of this, w hydrogen and oxygen combine u certain conditions to form water. W contains two parts of hydrogen and of oxygen, the chemical formula b H_2O.

If another part of oxygen atta itself we have hydrogen peroxide H_2O_2. It is interesting to note that are the only two hydrogen-oxygen pounds known to chemistry.

Another way of depicting water follows: H-O-H, which indicates two hydrogen atoms are linked to oxygen atom. Similarly, hydrogen oxide can be depicted as H-O-O showing two oxygen atoms linked gether and one hydrogen atom linke each. This method of depictin chemical compound is of great im tance, as will be shown later.

It is not possible to have compo where more than two oxygen atoms linked together because an oxyge oxygen linkage is easily broken.

gen peroxide is unstable because
vo oxygen atoms are readily broken

will readily be seen that an enor-
number of chemical compounds
e made by the union of atoms of
00-odd known elements.

re is a marked difference, how-
in the number of compounds avail-
containing a carbon atom and
containing no carbon atom. In
words between an organic and
organic compound.

se compounds consisting of a
of elements other than carbon
er about 20 to 30 thousand. Com-
ls containing the carbon element
er at least 400,000, and, because
n compounds can be made artifici-
n the laboratory, coupled with an
nding property of the carbon atom,
will be now referred to, the num-
f possible combinations appears to
initiless.

INS OF ATOMS

t was mentioned that a linkage be-
two oxygen atoms was a weak
e and that a linkage between more
two was impossible. This is not
th carbon atoms. This atom has
utstanding property of being able
k with any number of other carbon
n in chains, each carbon atom being
linked with another atom of a
nt element.

most cases only three other ele-
n are united with the carbon atoms.
are oxygen, hydrogen and nitro-
Occasionally there may be some
of sulphur, chlorine, phosphorus
he like, but the former three ele-
n usually predominate.

one enzyme, Ribonuclease, there
,876 atoms in its molecule, of
587 are carbon, 909 hydrogen,
xygen, 171 nitrogen and 12 sulphur.

ther peculiarity of carbon com-
ls is the fact that the usual chemi-
rmula is of no use in depicting
individual composition. There are
n carbon compounds with the same
ut of carbon, nitrogen, hydrogen
xygen, but are quite different in
rance and behaviour. Some may
gas, others solid; some a brilliant
, others colourless; some aromatic
thers odourless.

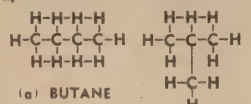
s, the formula $C_4 H_{10}$, indicating
toms of carbon and 10 of hydro-
an be either the formula for the
tane or the gas isobutane. These
are significantly different from
other, but, from such a formula,
would not know which gas was
ed. What, then, is the solution
s problem?

BUILDING BRICKS

mists were quick to conclude that
must be some arrangement of the
within the molecule which ac-
nted for the difference. They found
the atoms were somewhat like
in a building, which can be ar-
ged in different patterns to make
g structures. They can be laid
o end, like a chain, to build a
They can be built one above the
e or have branches leading in differ-
irections to make quite complex
ures.

his, a new picture could be drawn
epict a carbon compound, and, in
e to illustrate this, let us take again
as "butane," with four atoms of
and 10 of hydrogen.

nthe molecule of this gas the four
carbon atoms are linked together in a straight chain with hydrogen atoms linked to the carbon atoms as shown in fig. 1a.



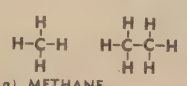
(a) BUTANE (b) ISO—BUTANE

FIG. 1

With "isobutane," however, there are only three carbon atoms in a straight chain and another carbon atom linked to the centre one. Hydrogen atoms are linked to the carbon atom as shown in fig. 1b.

Methane gas is found in the earth as "natural gas," particularly in mines. It is highly inflammable and known as "fire damp." At this point it is wise to mention that compounds made up solely of carbon and hydrogen atoms are known as hydrocarbons. This is a familiar term to people who study their diet.

Methane gas is the simplest known hydrocarbon and its structure is depicted in fig. 2a, where it will be seen to consist of one carbon atom with four hydrogen atoms hooked on to it. This is also an illustration of the fact that a carbon atom can hook itself on to four other atoms.



(a) METHANE (b) ETHANE

FIG. 2

While we are talking about gases we bring to light an interesting fact that the larger the molecule the easier it is to liquefy the gas.

Let us start with methane. This is, as mentioned above, an inflammable gas containing one carbon and four hydrogen atoms. It can only be liquefied by laboratory techniques.

If now we take two carbon atoms and link them with six hydrogen atoms we have gas called "ethane" (fig.2b) which is somewhat similar to methane but easier to liquify.

Three carbon atoms linked with hydrogen atoms gives us "propane" and, as already explained, four carbon atoms linked with 10 hydrogen atoms gives us "butane." Both these gases are used in cylinders under various trade names and are used to supply heat in gas ranges, soldering torches and so on.

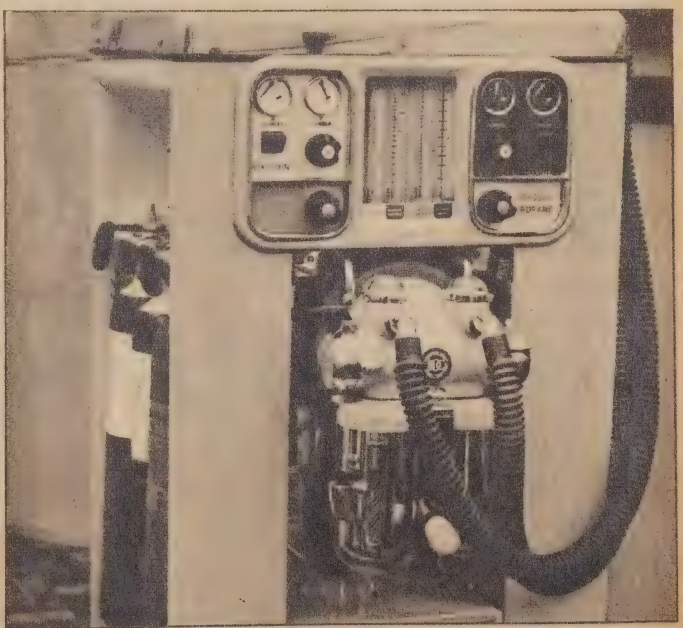
IDENTIFYING NAMES

Now, when we get more than four carbon atoms in a chain linked with the necessary hydrogen atoms we find that chemists have to identify them by names which denote the number of carbon atoms in the molecule.

Thus an arrangement of five carbon atoms with hydrogen atoms is a gas called "pentane" the prefix "pen" meaning 5. For molecules with six carbon atoms, seven carbon atoms and eight carbon atoms we have the words "hexane," "heptane" and "octane."

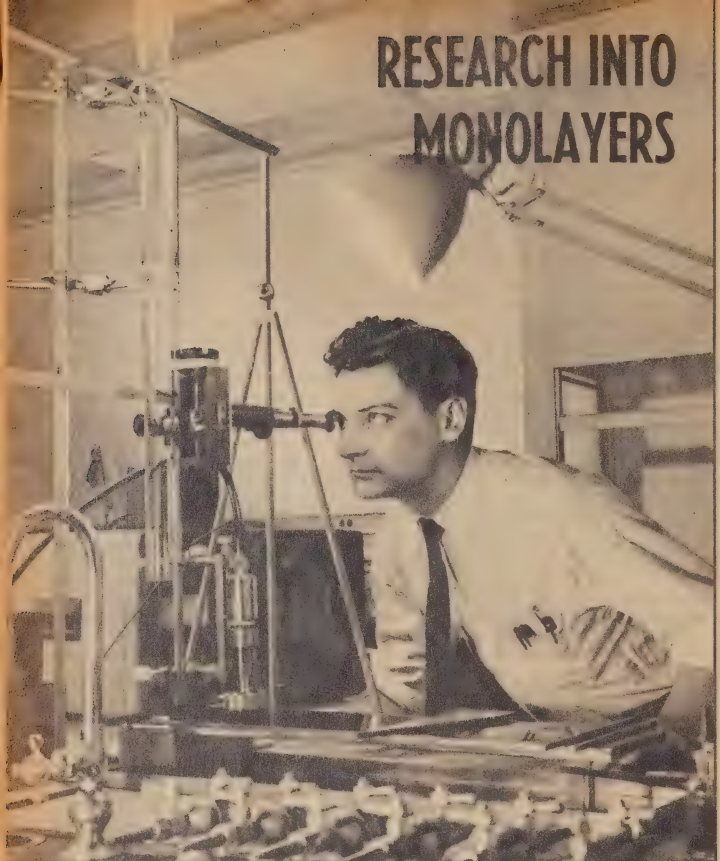
As we go through these compounds we find that they are easier to liquify until finally we have natural liquids in "heptane" and "octane."

Users of modern cars will be interested in the latter because it is used so often to denote the anti-knock qualities of petrol. Ordinary "heptane" petrol will knock like mad in most motors, whereas octane behaves quite differently depending on its "octane rating." This octane rating depends on the shape of the molecule, or the way in which the



This anaesthetic machine may seem a far cry from burnt barbecue steak, but most anaesthetics, from the old time chloroform to the modern cyclopropane, are based on carbon. A wide variety of other drugs is also built around the carbon atom.

RESEARCH INTO MONOLAYERS



New information on the deposition of monolayers—films one molecule thick—has been gathered by Dr George L. Gaines, shown above using a film balance. The study may have implications in corrosion protection, lubrication, adhesive bonding, and paint technology. Monolayers are also being used in research on the molecular structure of proteins and other complex molecules. Gaines studied the transfer of monolayers both from a water surface to a solid and by absorption from a solution on to a solid, using as the monolayer substance stearic acid that he had labelled with radioactive carbon-14. The latter enabled him to determine the completeness of the layers that were formed, as well as their resistance to removal by various treatments. He found that the efficiency of the formation or transfer of the layers may depend upon such factors as the nature of the solvent and solute, the speed of the process, gravitational effects, and temperature. The processes, he concluded, are more complex than had generally been supposed.

carbon and hydrogen atoms are linked together.

It is not necessary that the carbon atoms be arranged in a straight line. These can be branched in many ways. The carbon atoms can be linked together in a complicated variety of ways so that, whilst a compound with only four carbon atoms can be arranged in only two different ways, a compound with eight carbon atoms like "octane" can have the carbon atoms arranged in 18 different ways. Thus we have 18 ratings of "octane" from almost zero to over 100 octane rating.

Carbon atoms can also arrange themselves in the form of a ring, each carbon atom in the ring being linked with a hydrogen atom. The molecule of "benzol" is of such a nature and is very stable. (Fig. 3).

There are many other ring structures; countless numbers in fact. A familiar substance called napthalene, used as flakes or in little balls to keep moths out of the clothes cupboard or out of a miser's purse, has a molecule consisting of two six membered rings like the benzol ring.

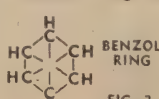


FIG. 3

The longer the carbon chain in the molecule the more difficult it is to vaporise and this fact is made use of in the fractional distillation of petrol.

The crude oil from the ground is heated first with a heat sufficient to vaporise those hydrocarbons with short carbon chains. This vapour is then cooled and liquified.

As more heat is applied the hydr bons with longer carbon chains vaporised and recovered and s In this way various grades of hydr bons are recovered from the most tile pentanes and hexanes through o ary petrol, kerosene to the low vo fuel oil.

There is also a process in oil ref techniques called "cracking." Here long carbon chain kerosenes and oil molecules are "cracked" up shorter carbon chains whereby they come the more volatile kerosene or rol.

There are hydrocarbons in petro oil which have longer carbon chains fuel oil and so do not vaporise easil

These are the lubricating oils. T with longer carbon chains than thi the petroleum jellies, or semi greases.

In the diagrams shown here so f will be noticed that all the atoms linked together with single lines. T lines are called "bonds." Sometimes mulas are seen where the atoms linked together with two or even bonds. Where this happens the ca atom can attach itself to one less hy gen atom because the extra bond lin the two carbon atoms should have used to link up with another hydr atom. This is illustrated in the for for "ethylene" (Fig. 4) as compare that of "ethane" (Fig. 1b).

FIG. 4

It will be seen that each carbon a of ethylene contains only two hydr atoms attached.

Where this double or triple bon occurs it represents a weak link in carbon chain; other chemicals will tack it at this point even though will not attack it elsewhere. Cons able energy is present in these mu bonds and, when the bond is bro this energy is released in the form heat.

A prime example of this releas energy lies in the gas acetylene (Fi

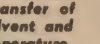


FIG. 5

The molecule of this gas consists of carbon atoms linked together wi triple bond and two hydrogen at The amount of energy at the triple is very considerable and when the is burned this energy is released as at a very high temperature.

In the manufacture of plastics come across the term "monomer" "polymer." If we start with the 'ethylene" we have seen that it double-bonded carbon molecule. molecule is called a 'monomer" and term is usually used to denote ever molecule with which we start.

Now if ethylene is heated to a temperature under considerable pre one of the two bonds is broken an pressure forces the ethylene mole together so that the broken bonds link themselves to other ethylene cules. This results in many hun of carbon atoms linked together long chain by single bonds and resulting compound is called "poly lene."

This substance is the well-k "plastic" sheet which is used to bags for containing food, clothing

(Continued on Pag

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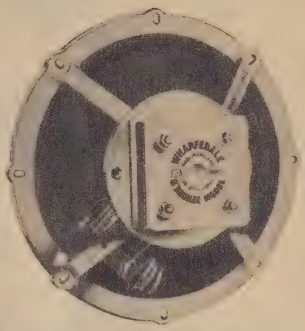

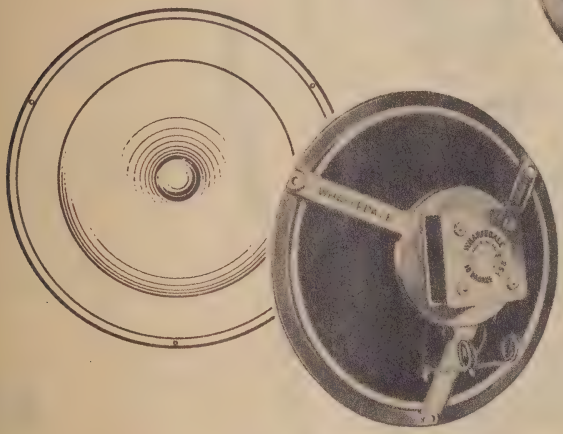

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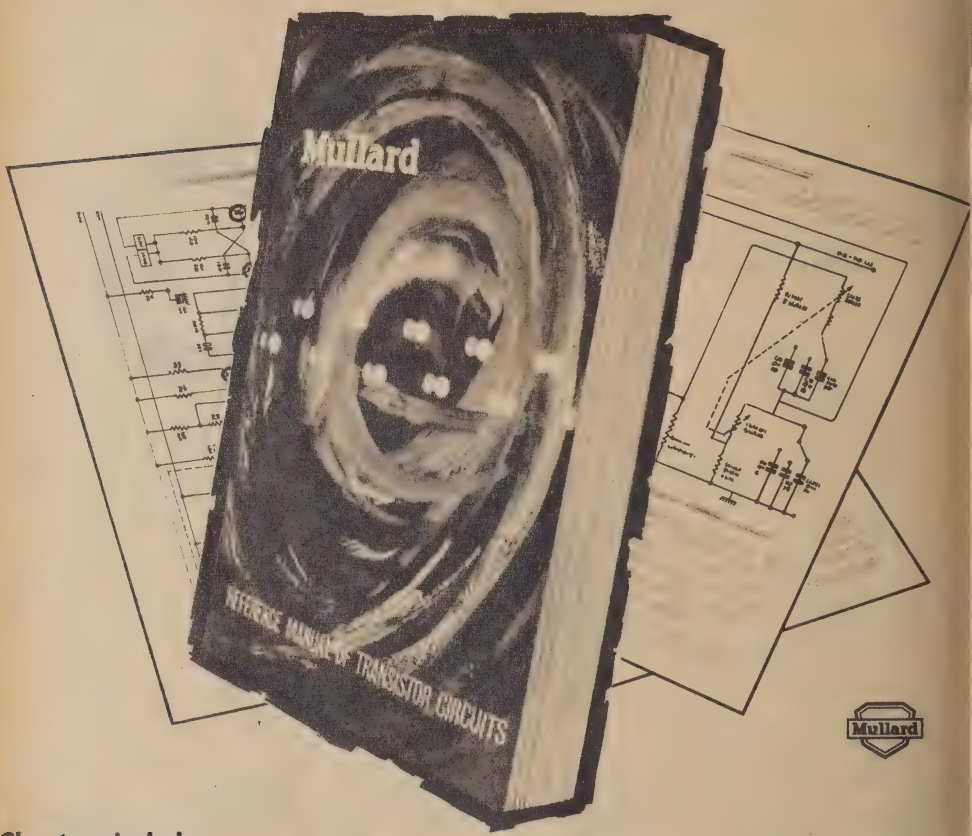

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MTI

Technical Review

IGH RESOLUTION FILM CAMERA CHECKS FILM QUALITY

A research camera capable of projecting a parallel line pattern of 50,000 lines per inch has been developed at the U.S. National Bureau of Standards. The camera, designed by C. S. McCamy of the photographic research laboratory, is a step toward the development of a standard method for determining the resolving power of photographic materials.

At the present time there is no standard method for measuring resolution. The bureau's work is part of a by a committee of the American Standards Association to establish such a standard. Five laboratories in the United States and Canada are working on methods which may be employed. By comparison of results they will be able to determine the factors which must be specified in order that all resolution tests on the same film or plate may yield the same result.

To insure that any limitations revealed by the test are those of the photographic materials and not of the test equipment the camera must be able to produce a line pattern much finer than can be resolved by the emulsion being tested. To test the new camera's full capabilities (50,000 lines per inch) it was necessary to use extremely high-resolution spectographic plates having a film speed of 0.025 as rated on the ASA scale for pictorial negative materials.

MICROSCOPE IN REVERSE

The camera's optical system is essentially a fine apochromatic microscope system operated in reverse to make an extremely small image of a large chart. The camera has interchangeable lenses. Objectives in use are an 8-mm lens having a numerical aperture of 0.65, which is equivalent to an f-number of 0.77, and a 16-mm lens having a numerical aperture of 0.30, or an f-number of 1.66. For this application the elements of the objectives were respaced and the interiors of the lens mounts were specially blackened to minimise reflections.

Film or plates to be tested are placed against a surface attached to the objective lens mount by a fine screw thread, with a gear mechanism permitting minute adjustment of focus. Films are held in place by a miniature vacuum back. The focus is first set by direct visual observation with a microscope. Several exposures are then made, setting a slightly different focus each time, until the position of best focus is found. The camera is operated at a constant temperature to avoid changes in focus resulting from the thermal expansion or contraction.

To secure even illumination of the targets to be photographed a compensator plate is placed between the lamp and condensers of the camera's illuminating system. The compensator is a glass sheet with a circular pattern printed on it — heavier at the centre than at the edges — which counteracts the tendency of the condensers to give higher illumination at the centre of the beam.

Provision has been made to place filters, either colour temperature-correcting filters or neutral density filters, between the illumination and the test chart. Colour-correcting filters are used to adjust the illumination for the particular emulsion being tested. Neutral density filters are used to obtain a series of exposures of varying illuminance. The maximum resolving power obtained in the series is recorded.

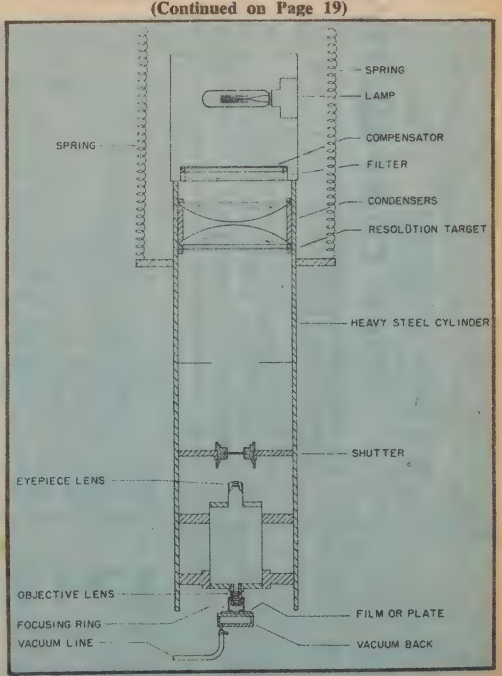
One important consideration in photographing the fine line patterns is to eliminate mechanical vibrations which would blur the photographs. To this end the camera, including test chart, illuminator, shutter and optics, is encased in a massive steel cylinder. The cylinder in turn is suspended from the ceiling by springs. The vibrations naturally present in the building were determined to be mainly 30 cps, 60 cps and 120 cps; since the springs used for support have a natural frequency of approximately 2 cps an effective mechanical insulation is achieved.

The new camera was used in an experiment to test the generally accepted correlation between resolving power and legibility at an extreme reduction ratio. In addition, the photograph made showed the extremely fine detail which may be recorded by this system.

In this experiment Bernard Fouquet, of the photographic research laboratory, made a photo-copy of the first page of the Bible at a linear reduction ratio of 1,000, thus reducing the area by a total factor of one million.

The page was first reduced 2.5 times to fit it into the camera's chart holder; then it was reduced by a factor of 400 with the new camera. If the entire Bible could be

(Continued on Page 19)



A simplified drawing of the high resolution camera set-up. The resolution chart is in form of a transparency in front of the condenser lens system. Note the spring suspension to minimise building shake.

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ELECTRONICS AID SUBMARINE NAVIGATION UNDER POLAR ICE CAP

e of the outstanding achieve-nts of modern times is the lear submarine and its ability travel long distances while r submerged. But this very lity creates its own problems. w is such a craft navigated, ecially under vast areas of in the arctic circle? This cle discusses some of these oblems and their solution.

U.S. Navy's operation of nuclear bmarines while submerged under ce is now routine, with sonar and electronic aids providing ability d downward projecting ice forma-nd icebergs in open water.

Seadragon, in its 8,000-mile At-to Pacific under-the-ice-cap trip pecialised sonar instruments, un-er TV and inertial navigation achieving a modern north-west .

r gave continuous information erhead ice thickness, sub-to-ice e, sub-to-bottom distance, location s in the ice (called polynyas), de-polynya outline ridges to allow g, and also provided continuous g of icebergs.

Navy has said that with this re-oyage the Arctic was made just sea, allowing nuclear subs to in such waters at any time. Sur-in up to three feet of ice is now d, cruising at high speeds in ice-logged waters can be done with yes picking out clear lanes.

DR SCIENTIST

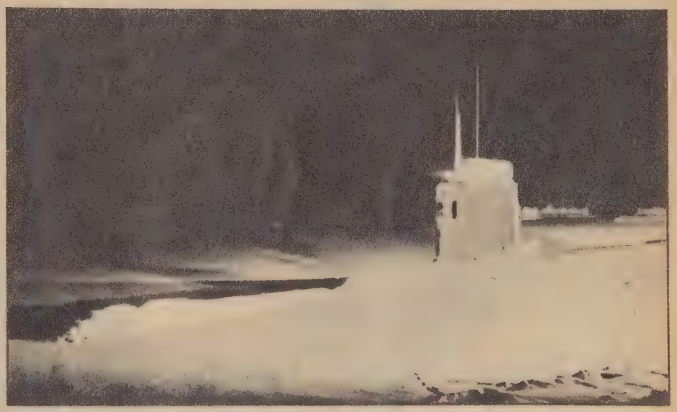
lo Lyon of Naval Electronics tory, San Diego, California, was scientist for the trip. NEL de-l the prototype versions of special-nar equipment used, tested them ious Arctic trips by nuclear subs. ur Roshon led a group at NEL id pioneering work on iceberg r design. The approach grew out y mine detector work.

the Seadragon's trip they supplied r designed to automatically cal-and continuously indicate over-e thickness. Sounding the under-the ice, and taking a depth gauge of the level of submarine sub-n, and subtracting the two gives kness.

fact that ice is a poor conduc-sound, and that the depth gauge ice as water when registering this technique to be used.

r instruments, designed for speci-poses, were supplied for the Sea-s voyage to EDO Corp., College N.Y. The firm sent engineer n Schere along as technical ad-He reported all instruments oper-ll, gathered data for an integrated ystem planned for future instal-

ded was a bottom sounding sonar, N/UQN-1 with a 6,000 fathom using a broad beam to ensure return during pitch and roll of marine.



This photograph of the U.S. nuclear submarine USS Sargo was taken at the North Pole after the submarine had surfaced through the ice. It was taken during the darkness of the Arctic winter, using an open lens camera and a series of electronic flashes to cover the required area. The USS Sargo recently visited Australia for the Coral Sea Celebrations.

A high accuracy, look-up sonar, type BQN-4A, gave distance to the underside of the ice when submerged. During a vertical rise in surfacing through a hole in the ice (polynya) overhead conditions of the sub were monitored at all times. Instrument range is 230yds, accuracy is ½ per cent of scale.

To determine outline of polynyas, for surfacing information, a special sonar, type BQS-7 was used. Called a polynya delineator, it directed a beam at an angle toward the underside of the ice, defining the outline of the pressure ridges formed when a hole is created.

ICEBERG DETECTION

Iceberg detecting sonar with direct reading display and high definition, of special design, was carried. Icebergs are frequent in the Arctic, the Seadragon encountered many in cruising off the west coast of Greenland. Definition and display were accurate enough to allow near-full cruising speed of fifteen knots to be maintained in iceberg fields.

A high sensitivity sonar listening system covering the low frequency spectrum was used as a passive listener. Various filters allow use in several modes of operation.

Sangamo Electric Co. supplied a standard SQS-4 echo ranging sonar for submarine detection.

A television system of extreme sensitivity, type BQX-1, with wide field camera mounted on forward deck, receiver in the control centre, provided high definition undersea images of ice fragments when surfacing; helped to correlate sonar data.

The system employs an image orthicon and electronic light amplifier; was designed and built by Bendix Corp., Friez div., Towson, Md. Bandwidth is 18 Mc., scene illumination of 20,000:1 can be accommodated through automatic control circuits.

Lens focus, light filter selection, iris diaphragm setting, and training of the camera in azimuth and elevation is done by remote control.

Sensitivity allows picture of ice formation at 400ft with half moonlight filtered through 4ft of covering ice; can reveal phosphorescent sea animals in dark water.

An R.C.A. video tape recorder, and a 16mm film camera made records of the TV coverage during the Seadragon's trip.

Navigation was done with Ship's Inertial Navigation System (SINS) which gave accurate heading even at the magnetic anomaly areas at the pole. Position was at all times important.

—From "Electronics".

STANDARD CAMERA

(Continued from Page 17)

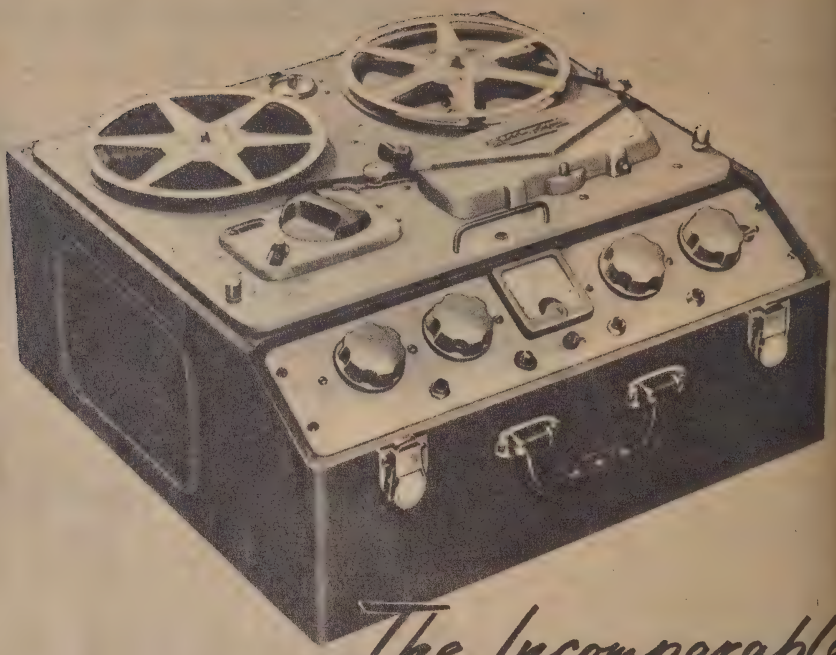
reproduced at this reduction ratio it would cover no more than ¼ cm^2, less than the area of Lincoln's head on a penny.

The microcopy was made on a high-resolution spectrographic plate using an exposure of 10 sec. at f/0.77. It is clearly legible when viewed directly at a magnification of 1,250 through a fine optical microscope. Blue light is used to view the microcopy, since a short wavelength enhances resolution.

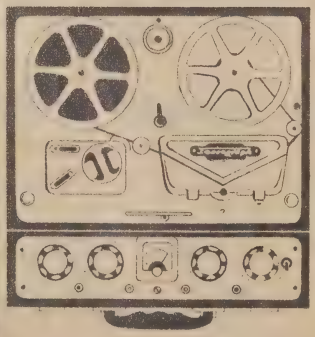
The bureau does not recommend this method for routine microcopying. Because of the difficulty in focusing, the problem of keeping dust from the field, the long exposures involved and the difficulty of viewing the copy, the method is too tedious for routine use.

Since one of the main purposes of the undertaking was to develop a standard method of measuring resolving power of photographic materials, the materials and components used were deliberately limited to those generally available.

(From N.B.S. "Mechanical News.")



The Incomparable Ferrograph



The first Tape Recorder ever to be designed and wholly manufactured in England was the Ferrograph. Today its leadership in the field of magnetic sound recording is undisputed. By virtue of its outstanding qualities, it has been chosen by the Services, by educational authorities, scientists and explorers, by large industrial organisations for an infinite variety of uses, by leading personalities in the world of music and drama, by record manufacturers and by leading radio stations.

These users have proved the reliability and qualities of the Ferrograph under circumstances far beyond your thoughts. But still one fact remains, the Ferrograph is truly INCOMPARABLE.

For illustrated literature, technical data and demonstrations, please contact

SOLE AUSTRALIAN AGENTS:

TAPE RECORDERS PTY. LTD.

60 CLARENCE ST., SYDNEY. BX 1571

SCIENTIFIC & INDUSTRIAL NEWS

D PRINTED CIRCUITS

NOVEL technique for making three-dimensional printed circuits he electronics industry enables the ed circuits to be made in an en- flexible form.

the same time the circuits can be in a virtually unlimited series of ns. In addition, they are said to elatively cheap to produce, while can be used for many applications which hitherto it has been impos- to use printed circuits manufac- on a mass production basis.

e new type of circuits is expected ad to quite large cost reductions any different fields of electronic ment. They are also expected to it possible to build equipment n could not previously be manufac-

e research and engineering depart- **Park Electrochemical Corporation,** Fifth Avenue, New York 17, New , U.S.A.

BETTER PLASTICS

NUTE glass beads used as a filler for moulded plastics gives a r and more rigid structure, accord- an American research laboratory t.

e tiny hollow beads—the laboratory them "micro-balloons"—produce rials as much as 30 per cent ger and 20 to 50 per cent lighter those with mineral fillers.

tificial insulating materials can be ced by combining the beads with flakes in a resin binder, it is stated.

emical and physical research labora- **Standard Oil Co. (Ohio),** Midland ing 15, Ohio, U.S.A.

L-PURPOSE "GREASE"

NEW dry lubricant is based on a fluorocarbon (TLT-17). It does not or run, and does not pick up dirt. kes a solid coating that remains dry lean. It is not affected by light or or oil or solvents.

e lubricant is applied with an aero- ispenser and will stick to all sur- —metal, paint, rubber, glass, plastic eather. The applications are numer- for the lubricant makes drawers, ows and even zippers slide easily revents them from jamming.

ed on tools such as garden spades vents dirt and grass from sticking m. It keeps off corrosion on metal for a considerable time.

E. I. Du Pont de Nemours, Wilming- Delaware, U.S.A.

TIN-NICKEL

METALLIC coating of unprece- dented properties is now finding in- ng favour. It is a chemical com- l of tin and nickel.

-nickel is harder than nickel, and lower coefficient of friction than tin kel. It is not ductile, whereas tin nickel are. Tin-nickel resists acid lkali attack like platinum. It is not ed by sea spray, immersion in salt atmospheres containing sulphur dioxide, or most of the cold, concentrated acids.

The coating is applied by an electro-plating process in which the electrolyte is a solution containing stannous chloride, nickel chloride, and ammonium bi-fluoride. The solution must be kept at 70 degrees Centigrade.

The electroplate thus produced has a faint suggestion of a rose-pink colour. It can replace gold as a protective coating for analytical weights. It can be used for the pistons and slides of brass musical instruments, and for kitchen utensils. It is one of the hardest coatings available anywhere.

Tin Research Institute, Fraser Road, Perivale, Greenford, Middlesex, England.

GLASS SEALS

RADIO tubes, vacuum vessels and many other glass components may be rapidly and securely joined to one another with the aid of a metal ring pre-coated on both flanges with glaze.

When the ring is heated, the glass melts and the glass components, also pre-heated, can be pressed together with the ring between them to form a vacuum-tight seal.

This technique, developed in the Netherlands, is said to produce a more reliable seal than methods using ground joints, rubber gaskets or wax seals. In addition, cracking of the glass is unlikely to occur.

Unsealing can be achieved without damage to the glass simply by reheating the ring.

Philips Research Laboratory, Eindhoven, Netherlands.

OIL SEALS

BUILT-IN magnets replace springs in a new American seal for rotating shafts. The maker claims that the magnets give more compact and tighter seals than springs would, as well as a more even distribution of the sealing force.

A circular permanent magnet is built into the shaft housing and attracts a ring of magnetic metal which is free to slide on the shaft. This magnetic attraction holds together sliding carbon faces on shaft and housing, preventing the escape of oil or hydraulic fluid.

The magnet is also said to be self-aligning when the shaft is fitted.

Magnetic Seal Corporation, 166 Bay Spring Avenue, West Barrington, Rhode Island, U.S.A.

FLAW DETECTOR

A NEW ultrasonic flaw detector is said to be robust enough for use on site and yet is also said to have a performance which provides an accuracy which is suitable for laboratory work.

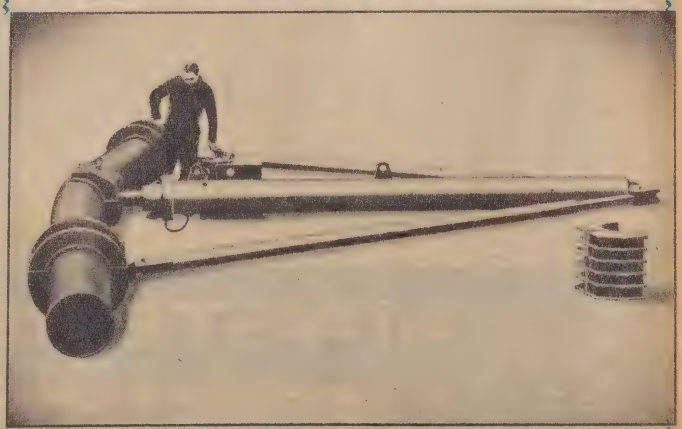
At the same time the device is said to be capable of operating up to unusually high frequencies for a portable unit—15 megacycles per second—without any loss in sensitivity.

This is important because it makes it possible for micro-cracking, or very small cracks, to be detected in forgings and welded parts which could not be detected if lower sensitivities were available and lower frequencies used.

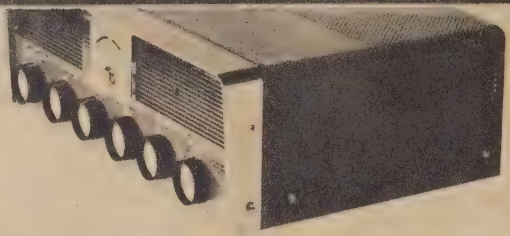
The unit can also be used to measure the thickness of very thin specimens.

Sonatest Limited, 15 Great St. James Street, London, W.C.1, England.

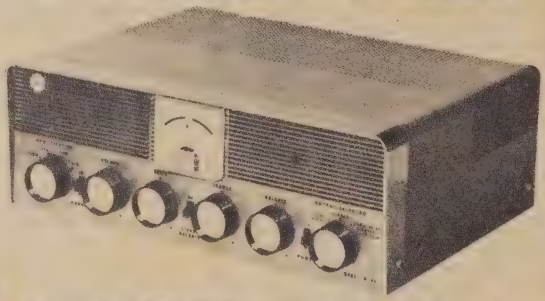
PIPES NOW BENT WHILE YOU WAIT



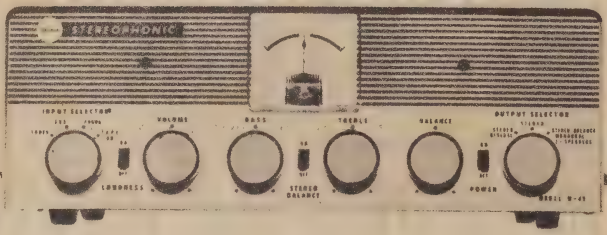
Designed to speed up the laying of large diameter pipe, this new portable bender is capable of bending up to 18-inch O.D. x ½-inch wall thickness mild steel tube. It will effect a 10-degree bend in one thrust in under 10 minutes. The pivotted outer arms simplify transport, while also allowing adjustment to suit the job in hand. Varying the length of the outer arms extends the effective stroke of the ram. (Chamberlain Industries Ltd., 3 Buckingham Palace Gardens, S.W.1, England.



A 36-WATT STEREO



AMPLIFIER FOR 85 GNS.



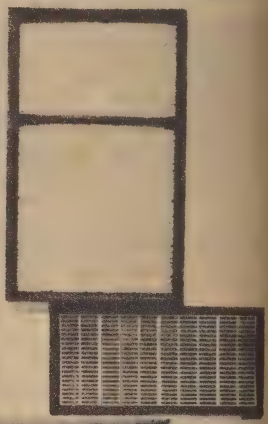
The Trio Model W-45 Stereophonic Amplifier has been designed and built for trouble-free reproduction of the highest possible standards. The twin 18-watt stereo sections will handle the loudest and most complex musical passages with effortless ease, while a switched Loudness Control (separate from Volume Control) permits the full dynamic range to be enjoyed even when listening at very low levels. The Trio will operate direct from the Decca and other high-quality pickups. Perfect balance is assured with the exclusive built-in Balance Meter. Trio also functions as a true single channel, single speaker, 36-watt amplifier for high-quality monophonic applications.

AVAILABLE ONLY AT MASTERSOUND!

FULL FREQUENCY

GOODMANS

COMPACT SPEAKER SYSTEMS FOR BOOKSHELF OR TABLE



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LAY-BY PACKAGE DEALS

FLAME CONTROL

NEW series of flame-controlling devices for igniting and monitoring lti-burner industrial installations has n developed. The system is of small e and it uses transistors instead of ves.

t is also said to possess a reliability greater than previous instruments of s kind. Plug-in electronic circuits are d, and it can be operated with either -fired or oil-fired burners or burners ng combinations of both fuels.

)ne advantage of the system is said be that it will discriminate between radiation from the flame and be un-cted by the latter event. They can trol up to six flames at once, accord- to the customer's requirements, and hoto-electric lead-sulphide cell is used "watch" each burner.

his lead-sulphide is linked to a tran-or amplifier which is sensitive to the ors which could lead to flame radia- causing false information to be sent the control-room or operated on by automatic control centre.

nformation from the amplifier is fed a silicon transistor, and thereby either the automatic control unit or to the tral control-room, or to both.

ther Limited, combustion safeguard sion, Caxton Way, Stevenage, Herts., gland.

STRONG ADHESIVES

SERIES of resin compounds now under development are said to sess an exceptionally high bond for ing together dissimilar materials.

he new resins have an exceptionally d ability to resist high temperatures. ds produced with the materials are to hold completely firm at tempera-s of from 500 degrees Fahrenheit to degrees Fahrenheit.

his means that they can be used, for mple, to assemble ovens. At the same it enables metal parts to be glued ther when normally using conven-al techniques they would have been ded together.

urther development work on the new mers is continuing, and they are ex-ed to find widespread applications only in aircraft production but also general industrial, mechanical en-ering.

he Monsanto Research Corporation, nsanto Chemical Co., St. Louis 66, souri, U.S.A.

SCREW-THREAD SEAL

NEW sealing material for screw-threads is being made in Britain. onsists of either a thin ribbon or a i n g of polytetrafluoro-ethylene .F.E.). This synthetic material is y soft, and at the same time has a low coefficient of friction.

his new application of it seems the ver to a problem faced by engineers many years—how to make a screwed nection watertight and gastight, ex- for oxygen with which it cannot be .

he ribbon or string is wrapped round thread of, for example, a pipe, and n this is screwed home the P.T.F.E. ft enough to take up the contours the thread without jamming it. F.E. is resistant to all chemicals and solvents and oils. It makes the perfect fluid-tight seal.

The non-reactive nature of P.T.F.E. and its low coefficient of friction means that a screwed joint thus sealed remains uncorroded and is easily unscrewed after years of use. The seal is expected to find a wide use in the chemical and electrical industries.

Richard Klinger, Klingerit Works, Sidcup, Kent, England.

HEAVIER THAN LEAD

A NEW type of ballast available in America is reported to be 50 per cent heavier than lead and still be fairly reasonable in price.

The material is a tungsten-based alloy available for such devices as gyroscope rotors and torsional vibration dampers which need high rotational inertia. It is also usable as ballast and counter-weights for airborne machinery, and is highly effective as a shielding against radiation.

Kennametal Inc., Latrobe, Pennsylvania, U.S.A.

SYNTHETIC "NATURAL" RUBBER

SYNTHETIC "natural" rubber is now available in development quantities in Britain.

First produced as a Shell product in the United States, a new plant is being put up at Pernis, Rotterdam.

Natural rubber as produced from the tree is mainly a polymer (that is, a material of high colecular weight produced from the joining together of many identical smaller molecules) of isoprene.

Up to recently, synthetic "rubbers" were all polymers of some other molecule. Now Shell has succeeded in polymerising isoprene, and so producing a very good synthetic equivalent of natural rubber.

All rubbers, natural and synthetic, have their own special properties. One synthetic rubber, for example, is better than natural rubber for tyres for small cars, whereas natural rubber, having greater resilience (or bounce), is more suitable for tyres on large vehicles.

The new Shell isoprene rubber has the resilience of natural rubber and is at the same time whiter and flows more easily when heated. It is free from contamination.

Shell Chemical Company, 170 Piccadilly, London, W.1, England.

CONTROLLED CONDUCTIVITY

A NEW plastic compound is said to have an exceptional ability to conduct electricity.

The compound, which is based on a vinyl-thermo plastic material, has all the normal qualities of plastic compounds. It can be extruded, laminated, calendered, or moulded into parts, or complete components of various shapes and sizes.

Electrical properties are spread uniformly throughout the material, and can be reproduced readily on a mass production basis.

The ability to predict the electrical conductivity of the plastic depends on the fact that its resistivity values are controllable.

Croxton and Garry Ltd., 16-18 High Street, Kingston-on-Thames, Surrey, England.

ADCOLA

SOLDERING INSTRUMENTS

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NO TRANSFORMER REQUIRED

Models for all volt ranges 6/7V to 230/250V.

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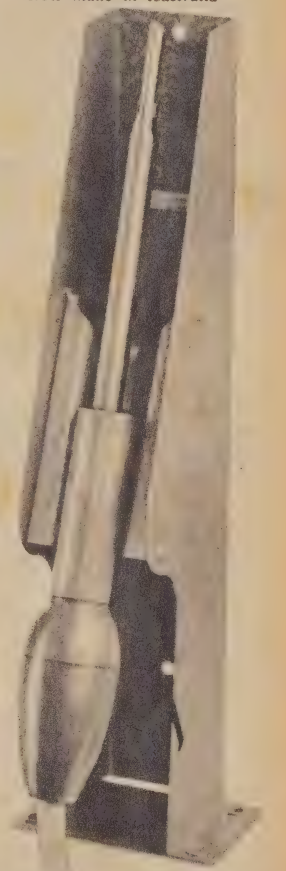

***ILLUSTRATED* L64** *3/16" Bit Model operating in Protective Shield —* **L6B.**

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Specialised tools for Radio and Electronics Equipment.

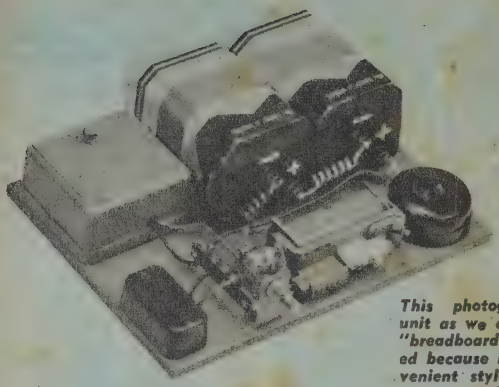
FURTHER INFORMATION FROM

ADCOLA PRODUCTS PTY. LTD.,

420 ST. KILDA ROAD, MELBOURNE. S.C.2.

— BM2441 —

By Keith Jeffcoat



This photograph shows the unit as we constructed it. The "breadboard" form was utilised because it is the most convenient style for a device of this type.

Moisture Triggers Off This Novel Alarm

Here is a simple, inexpensive, and easy-to-construct piece of gear which will gladden the heart of any hobbyist or any housewife. Designed to sound an alarm at the first sign of rain or any other form of moisture, it not only makes a useful washday aid but could be applied in a dozen other ways around the home.

IF you are mechanically minded, with a taste for the unusual, you could put one of these units to work automatically, closing the windows of the family home at the first sign of a sprinkle. Perhaps you like to relax with a good book while you run a hot bath before bed; let this unit be your indication of the tub having reached a predetermined water level.

Bed-wetting alarm, excessive condensation detector, control of automatic valves in water tanks, a novel form of doorbell system; there is no doubt that the applications of a reliable moisture detector are many and quite varied.

Many "rain detector" designs in the past have required vacuum tubes or thyratrons for their operation, making line voltage operation almost mandatory, and battery operation, at the best, expensive and cumbersome. Use of the mains restricts the possible applications of a moisture detector considerably; outdoor use is limited and applications involving possible body contact could be dangerous.

By transistorising such a device, we remove all possible danger of accidental electrocution and, at the same time, make possible the construction of an instrument which is both portable, economical and with numerous applications.

Using only one transistor and with a sensitive relay, the device can be ma to trigger on the moisture from an pelled breath at 12 inches from sensor board.

If desired, the instrument can be switched on at all times, since the sta ing current is only of the order of few microamps. Under these conditio the batteries should last almost th entire shelf life.

Basically the device consists of a mo ture sensing element ("sensor"), a p- junction transistor connected as "grounded-emitter" direct coupled a plifier, and a relay which is used switch the external circuit. In our ca this latter is a warning buzzer but could just as easily be the aforementi ed window closer or an electrically op ated water tap!

SENSOR PLATE

The sensor plate shown in the pho graphs of our unit is designed prima for rain detection and is construc from a piece of the printed circuit bo featured in last month's issue. It ta the form of two "combs" with int laced teeth separated by about 1-16th This ensures that, should a drop water fall on the plate, it is almost c tain to bridge the gap between two the teeth.

In operation, the sensor plate is co nected in the base-emitter circuit of transistor and is normally open, so t little or no collector current can fl through the relay. The relay thus mains open.

When a drop of moisture falls on sensor plate, so as to bridge the cont between the two "combs," the ba emitter circuit is completed and b current may flow.

This base current flow permits a c responding collector current flow to t place, though of a much larger am tude due to the current amplification the transistor. The collector curr closes the relay which is used to swi on the external circuit.

The actual sensitivity of the unit depend on the minimum current which the relay can be made to oper satisfactorily and the "beta" of the tra sistor or ratio of collector curr change to the base current change wh produced it.

BASIC CIRCUIT

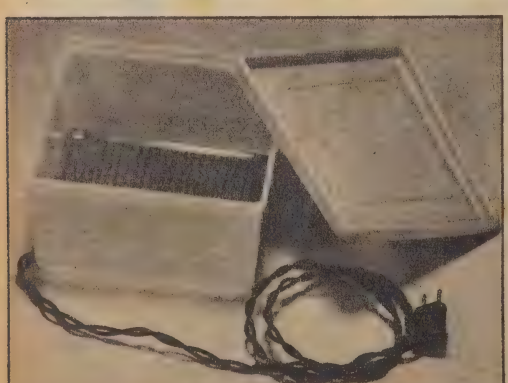
To illustrate this point more cle let us look at the circuit of Fig. 1 wh is the basic circuit of our unit.

Suppose that the beta, or current g of our transistor TR1 is exactly 100 that we require a current of 1.5 to flow in the collector circuit in o to operate the relay R1. In such a c with a gain of 100, RX would have be of a value which would allow microamps to flow in the base-emi circuit.

Leaving out the emitter base re tance, which can be ignored for all p tical purposes, simple Ohm's law us that, if the battery voltage is volts, RX would need to be 800K.

Actual tests in our laboratory sho that a single drop of rain water pla between the contacts of the sensor p showed a resistance of approxima 50K. Based on this, the circuit sh at Fig. 1, using a transistor with a of 100, is 16 times as sensitive a need be.

The transistor which we used in



For use as a rain detector a permanent "sensor" installation would be an advantage. The illustration at left shows one method of doing this. When not in use, the lid protects the board from bird droppings and unnecessary subjection to moisture which may limit its sensitivity.

ied model had an average beta of
and a potentiometer is placed in
; with the sensor plate to limit the
tivity to any desired figure. The
series 50K resistor RI is merely to
the base emitter current to a safe
: in the event of the sensor board
: accidentally shorted when the
ntiometer is at its lowest resistance
ion.

hile we have shown a particular type
ansistor in the circuit diagram, any
of a number of general purpose
) transistors could be used with
lete satisfaction. The only differ-
would be in the matter of sensiti-
which would, in any event, be ade-
in all cases. The following is a
f types which we know to be suit-

T152, SFT153, SFT122, SFT123,
08, 2N185, 2N106, 2N108, 2N109,
9, 2N196, 2N197, CK721, CK722,
, OC71, OC72, OC73, OC74,
, OC76, TS1, TS2, TS3, TS13,
2, TS163, TS618, TS619.

should be mentioned that this list
from complete, as there are liter-
undreds of types which would be
le. It will, however, serve as a
to the general nature of the type
le.

OF RELAY

relay which we used in our unit
standard type having a DC resis-
of 5,000 ohms, though any unit
a resistance between 1,500 and
ohms is worthy of consideration
ne circuit. The lower resistance
would require more current to
e them, however, with a conse-
loss of sensitivity.

he relay which you decide to use
ore than the one set of contacts, it
be advisable to remove those not
d, in order to obtain maximum
vity. To this end, it is also advis-
o bend or adjust the armature so
has the minimum travel necessary
se the contacts.

lector current and dissipation will
lly be held well within the maxi-
ratings of the transistor by the re-
e of the relay in the circuit. With
west value of 1,500 ohms the maxi-
current would be 8mA, while, at
her extreme, the 5,000 ohm unit
allow only 2.4mA to pass.

le it may be possible to use a
having a very low resistance, say
hms, the sensitivity of the instru-
would be so low as to be almost
le and there would be a strong
lity of exceeding the maximum
on the transistor, with rather sad
uences.

RY SUPPLY

a supply voltage we have two No.
ntern batteries. They were used
e they are quite cheap to purchase
e of sufficient capacity to operate
ne unit and its warning buzzer for
iderable time without needing re-
ent.

**should be noted that these bat-
do not normally have their
ty marked on them and that the
spring connection is the nega-
erminal. This is important as
al of polarity to a transistor
nearly always cause permanent
ge.**

shown in the photographs, the

PARTS LIST

1 Suitable transistor (see text).
1 Suitable relay.
1 50K ½-watt resistor.
2 6-volt lantern batteries.
1 300 ohm TV plug and socket.
1 Suitable on/off switch.
1 8 lug tagstrip.
Small pieces of scrap aluminium, piece of 5-ply 9in x 7in, buzzer or other indicator, wire, etc.

prototype unit was constructed on a piece of 5-ply timber measuring 9in x 7in. You may care to follow suit, gluing a strip of foam plastic to the underside, to prevent scratching of any surface on which it is placed.

However there is no reason why the unit should not be "dressed up" in a more decorative case, if so desired.

In order that this unit could be constructed by everyone from the experienced radioman to the relative newcomer to the game, we have included a layout and wiring diagram of the unit as we have constructed it.

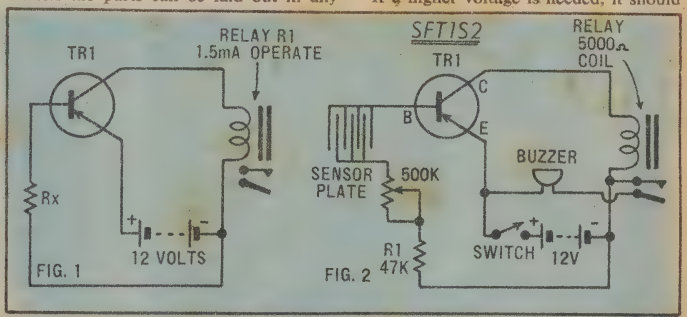
Actual layout of the instrument is non-critical and whether breadboard or chassis the parts can be laid out in any fashion which suits the individual requirements, without prejudice to the unit's performance.

Because it suits the breadboard style a standard 240 volt light switch is used as the on/off switch and a skirting board mounting 300 ohm television type plug and socket used to plug the sensor board into the unit. The relay is laid flat on its side and secured by means of a small aluminium bracket; a similar bracket is used to mount the sensitivity potentiometer.

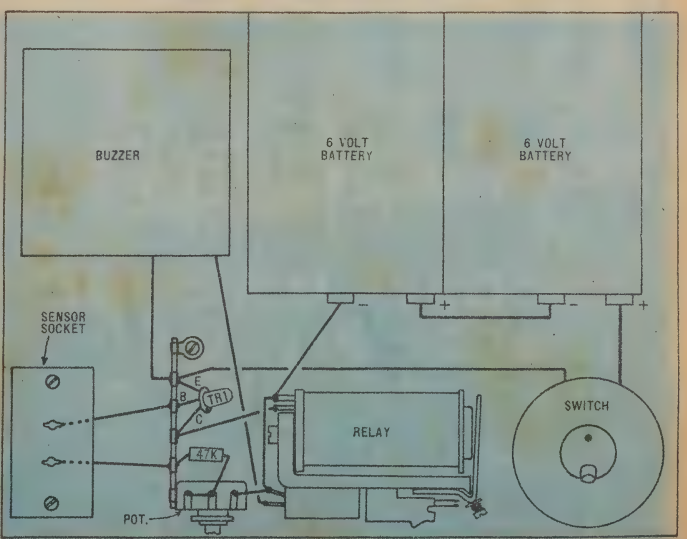
The transistor is mounted on the centre lugs of a modified 8-lug tagstrip. Circuit wiring to the lugs of the tagstrip should be completed before soldering the transistor in place and each of the transistor leads should be held with a pair of pliers while soldering to prevent excessive heat travelling up the lead and into the transistor.

The buzzer or other warning device which the unit is to operate should be capable of being energised from the instrument's 12-volt supply. Do not, in any circumstances, increase the unit's supply voltage simply to operate a higher voltage buzzer or indicator, or you may exceed the transistor's maximum dissipation ratings, with the aforementioned sad results.

If a higher voltage is needed, it should



Illustrated above is the basic circuit together with the main circuit diagram while that below is the layout and wiring diagram for those who wish to duplicate our original form of construction.



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from an external source and be
hed by the relay contacts, without
connection to the transistor part of
ircuit.

mentioned earlier, the sensor plate
nstructed from a piece of the print-
rcuit board mentioned in the articles
on this subject in last month's
The actual physical layout is easily
from the photograph of the unit; it
proposed to delve into the method
tching these boards as this was
ed in last month's issue.

you should desire to construct a
from materials which are already
nd you could do so by cementing
ce of tinfoil to a piece of plastic
utting the comb pattern out with a
blade.

riety of patterns could be used in
f the "comb" provided the foil is
y divided into two separate sections.
cement, of course, would need to
it negligible electrical leakage.

NDWICH" SENSOR

still further approach would be to
a "sandwich" consisting of two
of copper or brass flywire screen-
eparated by a piece of plastic "fly-
Overall dimensions of the sensor
be as large or as small as desired.
"flywire", sensor would be ideal as
d-wetting alarm.

ere condensation or water leakage
problem, the sensor plate may be
d under the suspected pipe so that
rst drop of water to fall will sound
arm. Locate the sensor at the low-
oint under the troublesome pipe.

automatic control of water level
ank or as an alarm to indicate that
bathtub has reached the desired
the sensor could consist of two
rods or tubes mounted in a plas-
sulating block. The rods should be
ted between ¼in and ½in apart and
ssembly fixed to the side of the
or tank so the rods project down-
to the desired level. The insulating
to which terminal connections
ade should be so located as not to
mpened by the water inlet pipe.

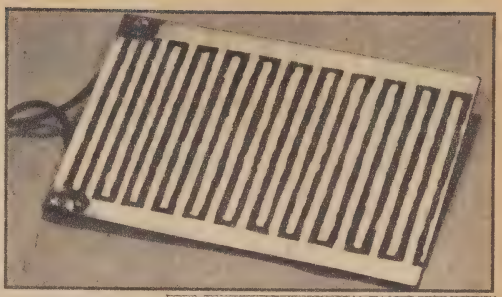
used for automatic tank level con-
a solenoid-operated valve could be
l in the inlet pipe, the solenoid
connected in series with a set of
lly closed terminals on the relay.

ION OF RODS

long as the water level stays be-
ie two rods the relay is open and
olenoid valve is actuated, permit-
ater to flow through the inlet valve
ito the tank. As soon as the water
s the pre-determined point and
contact with the sensor rods, the
is pulled closed, opening the solen-
rcuit and permitting the inlet valve
se.

en the water level drops below the
ods, as when water is drawn from
nk, the relay again drops out per-
the valve to operate.

ugh there are no doubt dozens of
nt ways in which this unit can be
to perform useful services around
me, one other application which
easily to mind is the aforemen-
novel form of doorbell. For this
piece of printed circuit board
be etched in an artistic design
would have two separate conduc-
it. A small notice could be pro-



This photograph shows the construction of the printed circuit sensor board with its two interlaced "combs". Details of etching these boards is given in last month's issue.

vided beneath the board to the effect that it is only necessary to place a finger (or fingers) anywhere on the board in order to ring the door chimes.

Such a device would, of course, be impractical for use in a location which is exposed to the weather, as it would automatically trip every time it rained!

Irrespective of the method chosen for assembling the sensor plate, care should be taken that the two conducting elements are not so close together that accidental short circuits may occur (resulting in "false alarms") nor so far apart that a single drop of moisture cannot make contact with both conductors (except in the case of the bathtub alarm or automatic tank control).

Connection of the sensor to the unit can be via any length of lead likely to be necessary, with the reservation that if the lead is fairly long it should have reasonably good insulation properties between the wires in order to prevent undue loss of sensitivity.

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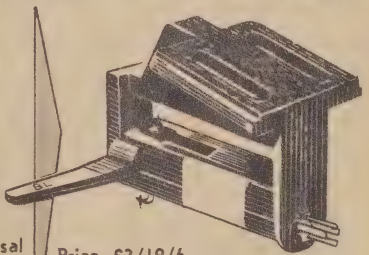
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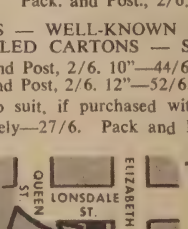

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Here's your answer, Tom!

This month we are dealing with the Circuit Magnification or "Q" Meter. The basic principle of the instrument is given, together with a description of two practical versions used for measurements of the various characteristics of tuned circuits. A brief idea is also given of the uses to which the "Q" Meter may be applied

By JAMIESON ROWE

WHEN a circuit consisting of an inductor and a capacitor is imed with a variable-frequency signal ge, the effective impedance of the it is different at each frequency. is due to the fact that the reacts of the two units are frequency deant, making the combination of the also frequency dependant.

at a certain frequency the effective dance of the L-C combination is ly resistive (the reactances having tively cancelled one another), the it is said to be resonant at that ency.

the resistive impedance of the cirat resonance reaches a minimum , as is usually the case with series inations of L and C, the circuit id to be SERIES RESONANT.

the other hand, if the impedance e circuit rises to a maximum value sonance, it is said to be PARALLEL NTI-RESONANT. As the name es, it is mainly a characteristic of lel combinations of L and C.

the L-C combination is composed re capacitance and pure inductance, mpedance at series resonance will be Similarly, for a parallel resonant ition, it will be infinite.

STANCE PRESENT

practice, there are no such things re—or perfect—inductors and capa-; and a certain amount of circuit ance is always present. This may ally be in the form of winding reice of the inductor, or leakage reice across the capacitor. In point of any condition which causes loss or ation of energy from the circuit be regarded as a resistive effect.

e effect of this resistance is to fy the impedance relationships so mpedance at resonance is no longer deal zero or infinity, but merely a num or maximum, as the case may Thus the depth of the impedance of a series circuit at resonance is ely proportional to the resistance onent of the circuit. Similarly, the nt of impedance rise of a resonant el circuit depends directly upon the of the resistance present.

te what this means in terms of circuits used for, say, tuning-in signals. The more resistance in a circuit, or the less in a parallel t, the poorer the dip or peak and broader" the tuning. The effect is y described by the degree of "selectivity" present, due to the fact that for simple tuned circuits such as we have been discussing, "sharpness" of resonance and the amount of dip or peak go together.

To describe the extent of the resonant peak or dip in impedance of such practical circuits, the terms "Q" (Quality Factor) or Circuit Magnification are used. Since we have just seen that resistance plays a large part in the amount of peak or dip, it is not surprising to find that it forms the basis for the definition of these terms.

Thus the Q factor of a circuit is defined as the ratio of circuit reactance to circuit resistance for a series tuned circuit of L and C, and the inverse of this ratio for a parallel tuned circuit (i.e., resistance over reactance). The reactance used may be either the capacitive reactance or the inductive reactance, since they are equal in value at resonance.

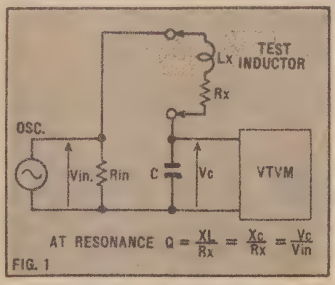

FIG. 1

(Note that we have defined CIRCUIT Q, which only has a meaning at the resonant frequency of the circuit, hence the statement above that XC and XL are equal in value. Later we will define the "Q" of a coil, which may have a meaning at any frequency.

The other term, that of circuit magnification, is in fact defining the same quality of the circuit, but defines it in terms of other effects. It first seems to have been used to describe the conditions in a series tuned circuit of L and C at resonance. Here, although as far as the input signal is concerned the reactances cancel, leaving only the resistance, each reactance has quite a high voltage drop—equal in fact to Q times the input voltage.

Circuit magnification and Q factor thus turn out to be one and the same thing, as they both describe the amount of increase in voltage across the reactance of the circuit at resonance. (In case you're wondering, the "Q times" voltage developed across each reactance cancels out that produced by the other, making the resistive voltage drop equal the input, as expected.)

BASIC CIRCUIT

Perhaps a look at the basic Q measuring circuit will clarify the matter. This is shown in Figure 1.

Before we go into the operation of this circuit, however, we should first settle what is meant by "Q of a coil". In most L-C tuned circuits, the resistance present is mainly associated with the inductance (winding resistance, etc.) the part contributed by capacitor leakage, etc. being negligible. This being the case, it has been found convenient to assume ALL resistance to be in the inductor, i.e., to assume the capacitor as perfect and the merit of a tuned circuit to be determined solely by the merit of the coil.

The term "Q of a coil" is therefore used, and is defined as the ratio of reactance to resistance of the coil AT THE FREQUENCY CONSIDERED. Naturally, the Q will change with frequency, because reactance is frequency dependant while the resistance component is also subject to variation with frequency.

Thus the statement "the Q of this coil at a frequency of —kc is 100" has quite a definite meaning, implying that if the coil is resonated with a capacitor at the

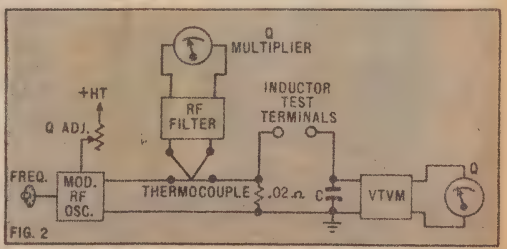

FIG. 2

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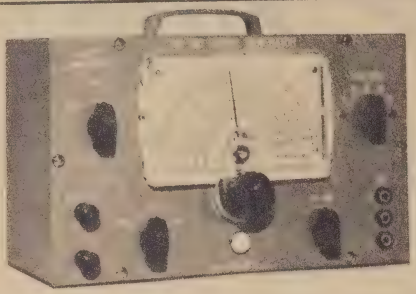

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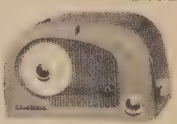

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quency specified, the Q of the cir- will be 100. The whole idea is ed on the idea of perfect capacitors the statement of the frequency when ng the Q of a coil.

low to the circuit of Fig. 1. Basic-, it consists of a series tuned circuit prising a standard variable capacitor and the unknown inductor (assumed be an inductance L and a resistance

ignal is introduced to the circuit from ariable frequency oscillator, shunted a low value resistor Rin to provide ery low impedance source. The input age to the circuit under test equals voltage across this resistor, and is lled Vin.

LTS AT RESONANCE

high impedance voltmeter (possibly TVM, as shown) is used to read the age developed across the capacitor esonance. Since the capacitor is as-ed to be perfect, this represents the tance voltage of the circuit, which be Q times Vin. To find the Q of circuit, and hence that of the coil e particular frequency concerned, all is needed is to measure Vin and Vc the high impedance meter and take ratio.

s the foregoing would imply, this circuit is only of use in finding the f coils. It may be used to perform r measurements, however, by mak-small modifications to the basic cir-or components.

y calibrating the frequency dial of the lator, for example, the instrument allow us to read off the actual fre-cy of resonance, which is most help-Then, by also calibrating the stan-capacitor dial in terms of its capa-ce (say in pF), at each position of ion, we can easily calculate the citive reactance (using XC equals over $2\pi fC$).

is automatically gives us the induc-reactance, since the two are equal. we can calculate the inductance, it equals XL divided by $2\pi f$. And lo the last step, we can find the l resistance, since it will equal XL ed by the Q.

e calibration of the capacitor also les the value of an unknown capa-to be found. This is done by first the capacitor C to resonate with a ard inductor at a certain frequency, then placing the unknown capacitor rallel with C. With the frequency ered, the amount by which C has reduced to restore resonance will the unknown capacitor.

TERMINALS

is explains why many commercial neters are fitted with terminals ed "C," which are connected lly in parallel with the calibrated itor C.

ere are other tests which the circuit be adapted to perform, such as rement of the shunt resistance of itors and the self-capacitance of in-rs. Time and space prevent us go-nto these, however, for we must on to two practical versions of the t.

ure 2 shows the basic circuit of one cal version. As before, there is a ated RF oscillator, feeding energy a 0.02 ohm non-inductive resistor. hermocouple provides the meter ed "Q Multiplier" with a signal pro-nal to input current, via an RF

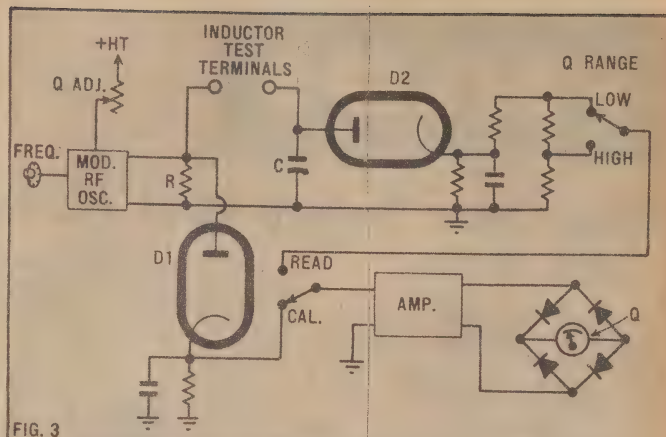

FIG. 3

filter to ensure the absence of frequency effects.

Since the value of the input resistor is known to be 0.02 ohms, the input voltage may be found from the reading of the meter, and is adjusted by the "Q ADJ" control of the oscillator.

The test circuit is the same as before, with a meter connected across the capacitor. This time, instead of a comparison between the two voltages, the operation becomes simpler and quicker. Firstly, the oscillator and capacitor are manipulated until resonance is indicated in the VTVM.

The oscillator output is then adjusted until the "Q MULTIPLIER" meter pointer is level with a line marked "X1," which may correspond to, say, 50mA of input current. This will mean that the input voltage is 0.02 x 0.05, or 1mV. The capacitor voltage, which corresponds to Q times this, is read by the VTVM.

This means that if the VTVM sensitivity is 1 volt full scale, the "Q" scale of the meter may be calibrated directly in terms of Q, up to Q equals 1,000.

HALF EARLIER VALUE

If the Q of the coil is higher than this, the oscillator may be adjusted until the input meter reads half its former value (usually marked "X2"). The readings of the Q meter will now represent twice their former value, since only half the input voltage is being fed to the circuit. (This explains why the input meter is marked "Q MULTIPLIER," as it indicates by what factor the "Q" must be multiplied.)

The main drawback of this type of instrument is the fragility of the thermocouple (not so much physically but electrically). Thus precautions must be taken to ensure that switching surges, etc., do not occur.

The other practical version shown (Fig. 3) overcomes this problem, and in addition requires only one meter.

In actual operation the circuit is closer to the original principle of Figure 1. Here, however, we have an RF oscillator which is modulated with a convenient audio signal (usually the 50 c/s mains).

Two diode detector circuits, using diodes D1 and D2, are used to enable the input and capacitor voltages to be measured. Since the outputs of the detectors are audio signals they may be amplified by a high-stability resistance-capacity coupled amplifier and then fed to a rectifier and meter circuit.

The operating procedure is as follows: With the meter switch on "CAL," the diode D1 detector circuit is connected, and the meter reads input voltage. The output of the oscillator is then adjusted until the meter indicates the specified output for correct calibration.

With the oscillator frequency and calibrated capacitor C adjusted for resonance with the test inductor, the meter switch is then moved to the "READ Q" position. This feeds the output from the D2 detector circuit to the meter, giving a reading corresponding to the capacitor voltage.

As before, the meter may be directly calibrated in terms of Q by arranging suitable multipliers in the detector leads. The circuit shown has a "Q Range" switch which effectively reduces the meter sensitivity for high Q coils.

Such, then, is the story of the Q meter, Tom. Next month we will discuss valve testers, another most useful class of measuring instrument.

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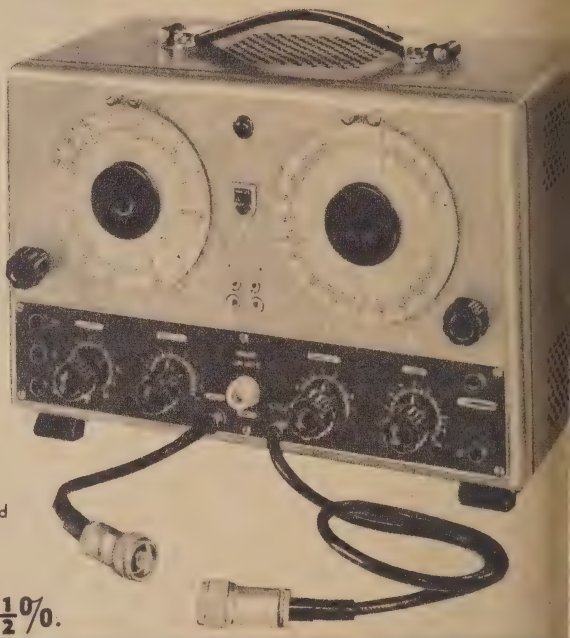

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ROM THE SERVICEMAN WHO TELLS

·om a fellow serviceman in New Zealand I have just received a very comprehen-ve booklet—apparently issued by the New Zealand equivalent of our Broadcasting Control ›ard—detailing the technical specifications of the TV service now coming into operation in that country. I feel it is sufficiently important to justify some comment.

R the most part this service is ntical with our own. Same line re, picture frequency, band width, nent of carriers within the band, channel, etc., such that the two is are generally compatible. If, en, we find some means to bridge asman, and exchange programs, should be no problem of standards sion.

wever, there are differences, main- regard to the channel and inter-te frequencies, and these immedi-raise the question of compatibility n Australian designed TV receiv-nd the New Zealand system. I e some of my New Zealand col-is may have to face up to this on in quite a few cases.

EMS COMPARED

at I am about to say may also some interest to Australian TV set facturers, if they intend to seek ts in New Zealand. However, I e that most of them will have this ation already.

ereas our system specifies IFs of Mc for sound and 36 Mc for vis-he New Zealand figures are 33.4 8.9 respectively. In regard to the els, I have prepared a simple table, herewith, comparing the New d system with our own.

ording to the New Zealand speci-n, the lower frequency channels, l to 3, will be used initially, partly e they are more readily available sent, and partly because it is hoped vill give better coverage over New d's uneven terrain.

nparing the New Zealand chan-/ith an Australian receiver we find New Zealand channel 1 is similar stralian channel 0, but with a dif-e of 1 Mc. N.Z. channel 2 is r to Aust. channel 1, and N.Z. el 3 to Aust. channel 2, but with rence of 2 Mc in both cases. N.Z. els 4 to 7 are identical with Aust. els 6 to 9, but N.Z. channel 8 o equivalent in the Australian re-. N.Z. channel 9 is similar to Aust. el 10, with a difference of 1 Mc.

GH ADJUSTMENTS

se differences are of such an order with most turret tuners, it should ssible to shift the local oscillator sufficiently by means of the vari-lug. Incremental tuners may pre- more serious problem.

wever, as I have pointed out on us occasions, the mere shifting of cal oscillator sufficiently to receive gnal is not necessarily a complete r. In order to preserve the correct ass and response shape, all other peculiar to that channel may also o be modified but, as they are sel-itted with slugs, this may not be so easy. In any case, it would need a sweep generator check for correct results.

If not corrected, this distortion of the response shape could have a significant effect on performance, causing poor definition, poor blacks, smearing, undue interference from adjacent channels, spurious radiation from the local oscillator, etc., depending on the extent of the modification and which end of the response curve was most effected. It most certainly should not be ignored.

Next there is the question of the altered IFs. Just how significant this is likely to be will depend a great deal on circumstances. In many cases it may be possible to "get away with it" completely and, in fact, it appears that quite a number of sets using Australian standards have been built or bought by New Zealanders and appear to be working quite satisfactorily so far.

ALWAYS RISKY

However, the use of a "foregn" IF must always involve some risks and there are two major ones we should consider. One is that the IF will fall in spectrum space allocated—or to be allocated — to other services, resulting in severe interference to TV reception whenever these services operate within range of the receiver.

In this case, for example, it is quite possible that the New Zealand authorities may licence other services in the general region between 30 and 33 Mc; a perfectly safe region as far as their own TV receivers are concerned, but potentially disastrous for an Australian receiver.

An even more serious possibility is that, unless an IF band is very carefully chosen for any particular system, an IF harmonic may fall within one of the assigned TV channels. A typical example is our own system, where the second harmonic of the video IF (36 x 2 equals 72 Mc) will beat with channel 2 sound carrier (69.75 Mc) to produce a 2.25 Mc beat. This manifests itself as a coarse bar pattern, breaking into a herringbone pattern when the sound carrier is modulated. (Serviceman, May, 1959).

Assuming sets of good design, this trouble is normally encountered only under conditions of high signal strength. This is generally in suburban areas where, due to ghosts, it is necessary to employ a high gain aerial. Pads or traps are often employed to eliminate the trouble.

Judging from the New Zealand specification, this factor has been the major one governing the choice of IFs. After specifying the IFs the following significant statement is made:

"For the channels allocated in New Zealand these IF values give the best compromise between the various forms of interference which can arise from image responses, IF difference responses, IF harmonic interference, and beat oscillation radiation."

FUTURE PROBLEMS

And what is the future of existing receivers, made to Australian standards, and currently in use in New Zealand?

Here, I think, each case will have to be treated on its merits. If the tuner is capable of receiving all the channels in a particular area, and the owner is happy with the results, there would seem no point in modifying it for the time being. (Except, of course, that having read this, the owner may no longer be happy with the results. He will be convinced they should be better, results notwithstanding!)

The most serious difference between tuners is that there is no equivalent of New Zealand's channel 8 in the Australian system. However, since the lower frequency channels are to be used initially, this omission may not be serious at present. And, by the time it is, the owner may be due for a new set anyway.

Much the same applies to the interference problem. Provided the set behaves satisfactorily, there would seem to be no point in disturbing it. However, it must be realised that these problems could arise some time in the future, due either to the establishment of services in the 30-33 Mc band, or to an increase in TV signal strength. The latter could be due to experimental services being replaced with permanent, high

AUSTRALIAN, N.Z. TV CHANNELS

Aust. Channel	Freq. Mc	Nearest Equiv. N.Z. Channel	Freq. Mc
0	45-52	1	44-51
1	56-63	2	54-61
2	63-70	3	61-68
3	85-92		
4	94-101		
5	101-108		
5A	137-144		
6	174-181	4	174-181
7	181-188	5	181-188
8	188-195	6	188-195
9	195-202	7	195-202
		8	202-209
10	208-215	9	209-216
11	215-222		

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r ones, or to a change in the r's location.

any case, the economics of the es would have to be balanced st the severity of the problem, re- ering that a fair amount of money be involved. Although it might ssible to obtain new "biscuits" for ner, and fit them without much le, there is a good deal more in- d than this.

y "biscuits" likely to be available it the New Zealand channels will ertainly be designed on the basis New Zealand IFs, making it diffi- o effect one change without the Unfortunately, a change of IFs likely to be simple. It probably mean new IF windings throughout rip, including the IF winding in ner.

MPLETE SET-UP

course, with luck, it may be pos- to simply adjust the existing wind- but it would be fortunate indeed these could be shifted by the ed amount without some doctoring. y case, it would call for a com- sweep generator set-up and some- ith a fair amount of experience to even a reasonable chance of suc- s.

is it would seem that, while some stralian sets appear to be performing storily under these conditions, it be unwise to tempt fate unneces- If it is necessary to take an Aus- set to New Zealand, the fore- points should be carefully con- and, ideally, the local manufac- approached with a view to having cessary modifications made.

story must also appear rather frus- for the home builder, particularly who look to the Australian market ir designs and components. How- he picture isn't all black. Australian s should still prove quite suitable, ly point to watch in most cases the selection of a tuner and IF signed to New Zealand specifica- s

RING IDEAS

Finish off this month I feel prompt- say something about two very on misconceptions which enjoy a ring popularity among the (tech- l) younger generation. Both con- weep generators and the like.

first is in regard to the perform- equirement of any CRO which is used for sweep alignment. It is surprising the number of experi- 's and budding servicemen who, planning to build or buy a CRO is purpose, can think of nothing an the most elaborate instrument bandwidth in the region of 7 Mc. a price in proportion!

In I raise my eyebrows at this de- and inquire why such a costly ment is contemplated, it is invari- pinted out that, since the IF band- is of this order, it will obviously a CRO capable of accommodat- figure. And, although they don't they look at me with a pitying ion, as if to say, "I thought know that."

afraid some of them take quite a nvincing that the bandwidth has o do with it. That, in fact, it is e rate of sweep which counts and that almost any CRO worthy of the name should be good enough.

But it's quite true. The signal fed to the CRO is nothing like 7 Mc, being the output from the video detector from which (ideally) all the IF signal has been filtered. All that is left is the amplitude variation caused by the strip's response shape and which is repeated at the sweep frequency.

Since most generators sweep at 50 cps, the worst possible case the CRO could experience would be a 50 cps square wave, and even this is most unlikely. I'm a trifle rusty on the exact figure, but I seem to remember that we need only reproduce odd harmonics up to about the 11th in order to reproduce a fully recognisable square wave.

On that basis any CRO capable of handling 1 Kc would be more than adequate, whereas it would be a poor device indeed that couldn't handle at least 10 Kc.

So think carefully before you decide on a performance figure. There is no doubt that a wide band CRO is a very useful TV instrument for other reasons, but don't base your decision on the completely false premise that it needs to equal the bandwidth of the system for alignment.

MARKER PIPS

Secondly, a question about the marker pip. We all like this to be as short as possible, for obvious reasons, but just what governs its length? I have heard the blame put on the marker generator, the sweep generator, even the coils under test. Everything, in fact, except the real culprit.

The marker pip is a beat pattern, produced when the sweep generator comes close enough in frequency to beat with marker frequency. But how close is "close enough?" Any two frequencies, no matter how widely separated, will produce a beat if the circuit is favourable. In theory, therefore, the sweep and marker frequencies should be able to produce a beat pattern at each and every point on the trace.

For example, let us assume that we have a marker frequency at 33 Mc. Even when the sweep generator is at 30 Mc., or 36 Mc., it will still beat with the marker. Admittedly it will be a 3 Mc. beat, but this is of little consequence if we assume that the video detector and associated circuitry is capable of handling this frequency.

Why, then, in practice do we not experience a "pip" which extends the full length of trace? You know something; we are back to our CRO. If our CRO has a wide enough response, something very like this will happen, and it becomes necessary to deliberately restrict its response in order to produce a suitable pip.

So, far from being necessary, a wide band CRO is, in fact, highly undesirable for this application. If it is a wide band type it has to be made "narrow band" artificially.

So, if a particular sweep set-up exhibits an unusually wide "pip" don't blame the sweep generator, the marker generator, or the IF strip. Check the CRO and try by-passing the vertical input terminals with various values of capacitance until it assumes the required proportions.

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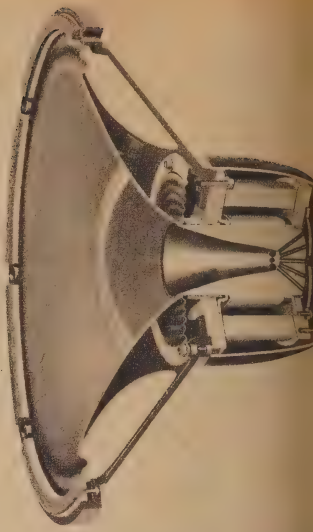

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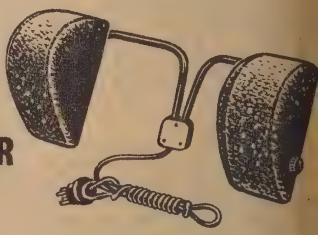

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Column Speaker For Halls, Churches

following article discusses the design and likely uses for sound mn type speaker systems and suggests a typical example. The as described, would be well suited for use in churches, halls, and itions where a long, narrow enclosure can more readily be blended into its surroundings than a more cubical shape.

Neville Williams & John Davidson

T and foremost, it is necessary define exactly what we mean eferring to column loud speaker

are columns and columns, the ieties having very little in com- fact, they are almost diametri- posed in purpose and operation. kind of column with which we T concerned is that currently find- our for modest, though still good mplifier systems. Prompted large- nterest in stereo sound reproduc- need has arisen for loudspeaker hich occupy a minimum of floor nd which can even stand in cor- hind lounge furniture, etc.

atisfy this particular need, loud- units have been contrived in he basic speaker (generally about is mounted face up in the top llow column, some three to four h and of cross section just large to contain the speaker cone. ns," which have been pressed into include concrete or earthenware wooden structures and tubes of ardboard/cum papier mache.

OM VENT

ment involves supporting them floor slightly to create a bottom ning the interior with padding supplementary tubes and placing tor above the loudspeaker cone erse the sound in a horizontal n. And, of course, the exterior y needs to be hand painted or in wallpaper to give it some air esticity.

ort, this kind of column is yet approach to the hi-fi-in-a-small- roblem which is so familiar these s we said before, it is the type of with which we are NOT con- here, although the foregoing re- may well trigger off a reaction will oblige us to do something hem before we are much older.

type of column with which we oncerned is the one which has sed in one form or another for ears, for public address installa- Coverage and speech clarity are ajor requirements, with fidelity ily taking second place.

public address type sound col- nvolves (usually) four or more akers mounted in a vertical line face of a tall, column-like enclos-

voice coils are interconnected to in-phase operation of the cones, so that they all move inwards together and outwards together under the influence of the driving signal. They simulate, in fact, a single elongated cone, no wider than any one speaker but as long as the overall stack.

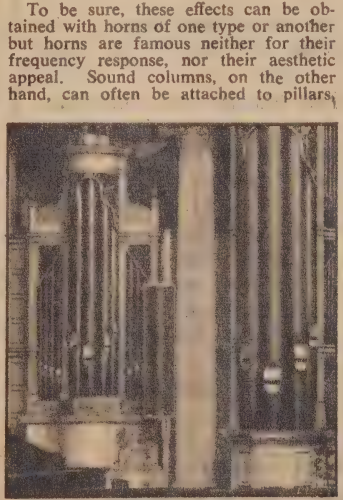
Sound tends to be radiated in an arc, forward and sideways from the column but not steeply upwards or downwards. Reason for this is that the cones tend to be additive in the effect on air ahead of the loudspeakers but to cancel at oblique angles in the vertical plane.

This can confer a big advantage in buildings with high ceilings, in that echo is likely to be less of a problem if the original sound can be concentrated towards the audience and away from the ceiling zone.

Such directivity can also be put to good use in limiting acoustic feedback, particularly if augmented by the discreet choice and placement of microphone.

Again, by using a column or columns above the front of the audience, but angled slightly towards the rear, the latter can be served without creating an intolerable level close to the speakers.

To be sure, these effects can be obtained with horns of one type or another but horns are famous neither for their frequency response, nor their aesthetic appeal. Sound columns, on the other hand, can often be attached to pillars,



Over fifty loudspeakers are used in each of two huge sound columns installed by AWA in the Sydney Town Hall. They combine high fidelity with extremely high acoustic output.

Polished, faced with plastic cloth and with gold trim around the edges, the completed column is quite impressive in appearance. It can house up to 6 9x6-inch speakers, as desired.

merged into architectural features, decorated in various ways or even built into stage and procenium arrangements.

In practice, they come in sizes ranging from a few square inches in cross sections and two or three feet high, to square feet in cross section and many feet in overall height. They use anything from half a dozen three or four-inch speakers to an imposing array of twelve-inchers!

The performance varies to much the same degree. Some of the very small columns, often employed in hotels, etc. for paging and background music have no more to offer in the way of fidelity than a mantel radio set. At the other extreme, the huge columns built into the Sydney Town Hall can boast the response and power handling capacity necessary to simulate a grand organ. In between are a variety of types with equally "in between" characteristics.

The plain fact is that almost any column loud speaker will exhibit the kind of sound radiation pattern that one would expect—at middle frequencies. But, at the ends of the range, the problems of a column are not basically different from other systems. The high frequency response is still limited by the capabilities of the individual speakers, while the bass response is a function of cone resonance, enclosure volume and the various manipulations which can be attempted in this region.

While these manipulations can modify the result a good deal, it is nevertheless not too far from the truth to accept the premise "the bigger the box, the bigger the bass." And it is certainly true that the smallest columns have no bass output to speak of, however good they may be in other respects.

While, as we said earlier, extreme

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fidelity may not be the prime obj in a public address installation, natural to seek the most favourabl sible compromise with the conf factors of cost and bulk. But, allowing for fairly generous ide regard to enclosure volume, response is likely to pose a serious lem.

A typical column of mediun may use a number of 8-inch or inch speakers, having a cone resc of about 85 c.p.s. Used in an backed cabinet, such speakers reasonably smooth response down frequency, the output tapering off s below it. Reproduction is not n "coloured," though lacking in the bass register.

RESONANCE RISES

If the rear of such a speaker is in, however, to eliminate randon radiation, cone resonance rises markedly. Furthermore, if severa speakers share the one sealed enc the rise in resonance can be co able, because each cone behaves as if it is contained in a box, only an equivalent fraction of th volume.

In practice, the cone resonanc easily rise from 80 c.p.s. to double the figure, producting a c tion which some have described "wooden" or "boxy" kind of response.

The situation could be reliev using speakers with a much lower cone resonance, but with difficul other directions. Such speaker likely to be special or importec and considerably higher in p which becomes a major factor using at least four of them per enc

The lower cone resonance longer voice coil travel; this nece a longer voice coil and a possib of sensitivity or else the expens bigger magnet structure to mainta sitivity at an acceptable level. I the problems encountered are lined in our article "Big Bass Small Enclosures" in the February issue (page 100).

DIFFERENT STANDARD?

Significantly, however, one choose to apply quite different st and therefore a different order promise to something intended p for public address, as compare something for home hi-fi listenin

A further possibility has to the use of internal padding in closure and the provision of v ports.

Padding is desirable to absorb reflections in the middle and register but it cannot obviate the cone resonance, as mentioned e

The use of a simple vent or likely to be disappointing, too, in narrow column structure. It wo pear from observation that t serves well enough the speaker c it but is progressively less effec those further away. The most speaker (or speakers) still exhibit ficially high cone resonance, wit sive acoustic output at the reson quency.

This objection can be overco degree by using a principle fea the so-called R-J enclosure. volves mounting the speakers or plementary baffle, which is s

from the front panel proper by a
ılly adjusted distance. The rear
is therefore vented through the
between baffle and cabinet front
the total length of the column.

ile not ruling it out as a possible
ach, objections to the scheme in-
the extra material and woodwork-
involved, the sharpness of the
ınce peaks so produced and the
l nature of the adjustments in-
l if the benefits of the scheme are
fully realised.

alternative scheme, which is
ly favoured in some quarters, is
ate a distributed vent effect by
g a line of holes (about 3/16-inch)
one side of the front baffle from
bottom of the enclosure.

USTIC RESISTANCE

s provides the necessary distributed
o serve all speakers equally, while
atically producing high acoustic
nce and a broadening of the
nt peaks. The number of holes
ed, determining the total effective
rea, is dependant on the enclosure
e and the fundamental speaker
resonance.

o happens that a recent brochure
d by the Rola Company features
l column-type enclosures, intended
inch, 8-inch and 9 x 6-inch ovals,
four speakers in each case. The
speaker arrangement is attractive
t the cones can be placed end to
obtain a large effective overall
with restricted column width.
enclosure is about 5 feet high,
nder 1 foot across the face and
10 inches deep. It is padded in-
y but completely sealed.

intalising feature, from the home-
's point of view, is that it will
ite cut from a single 6 x 3ft sheet
wood. We reckoned that a con-
le saving in cost would be pos-
with little change in performance,
scaling to cut from a single sheet
ing ¾-inch rather than ¾-inch ply-
for the basic structure.

determined also to experiment
imple vent arrangements, in the
f extending the bass response.
cabinet was therefore proportion-
be as large as possible from a
plywood sheet, the joints being
ed to present unbroken surfaces
sides for subsequent polishing.
p, rear and bottom will not usu-
seen, while the front will nor-
be finished with beading and plas-
h.

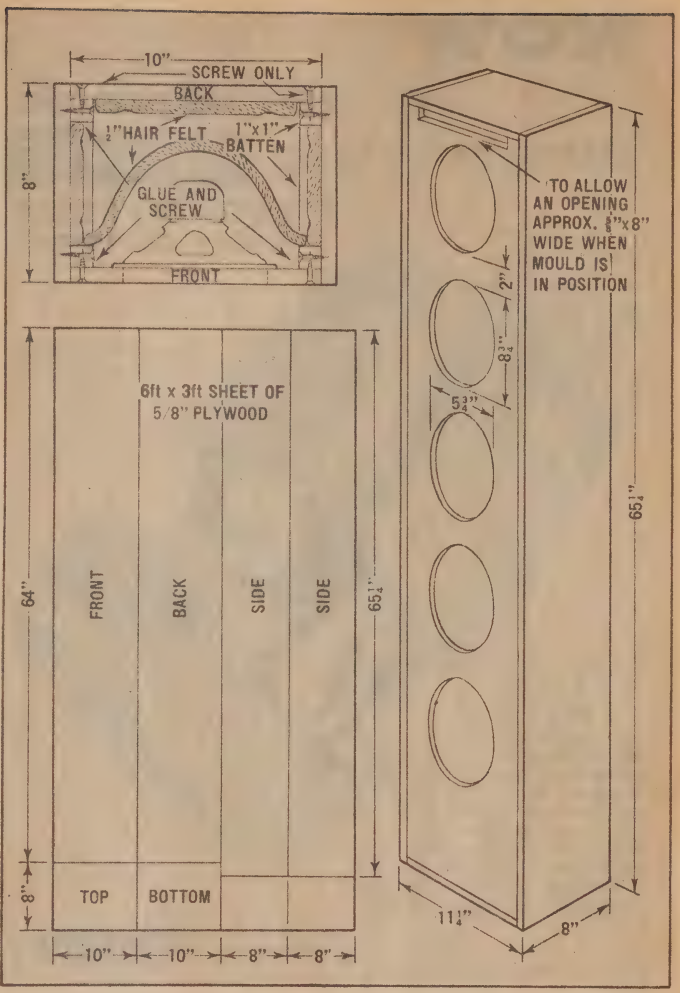
LLEL CONNECTION

slim, vertical line of the resulting
is not only pleasing in itself but
table to a variety of speaker ar-
ents. It would be possible, for
e, to accommodate six 8-inch
speakers down the face, with a
of holes, as already mentioned,
as a distributed port.

ct, there is room for six 9 x 6-
als, mounted end to end, though
the holes would call for care,
not to fracture the plywood left
the holes.

e some may, in fact, want to use
akers, we imagine that others
more than satisfied with five and
ith a group of four.

this assumption, and with the
idea of leaving two inches of
between adjacent holes, we cut
val holes of the appropriate
ions in the front panel. We had



These sketch plans indicate how the plywood sheet should be cut and how the panels are assembled. Note the use of 1 x 1-inch internal cleats to strengthen all corners and the use of internal padding to damp stray middle frequency resonances.

in mind primarily to use four of the holes for speakers, retaining the fifth for subsequent treatment as a vent, a port or acoustic resistance.

Alternatively, it could take a fifth speaker, with some other form of venting, though prime attention was given to the four-speaker arrangement.

The initial and natural step was to put the speakers in line in the top four holes with the bottom hole vacant. However, as mentioned earlier, it soon became evident that the vent was too remote from the top speaker to serve much useful purpose, allowing its cone resonance to be too high and too prominent for best overall results.

It subsequently became evident that an almost endless variety of minor impedance peaks could be created by "doctoring" the main port, by creating other ports or mounting the speakers back from the baffle to provide minor venting beneath the pad ring. However, while these modifications provided interesting observation on test instruments they looked far too chancy to recommend as an approach for home-builders.

A further complication also threatened.

Rola engineers had expressed to us the desirability of operating all voice coils in a column in parallel, in order to ensure, as far as possible, in-phase operation of the individual cones. Contrariwise, we would have preferred a series arrangement of low-resistance voice coils, to give something like a 15 ohms impedance without need for a supplementary auto transformer.

It soon became evident, however, that fiddling with individual speaker mountings produced a basic dissimilarity in impedance behaviour, which made the possibility of anything but strict parallel connection even more remote.

Again this general background, and to cut a long story short, we finally mounted two of the speakers in the lower holes, leaving the centre hole to

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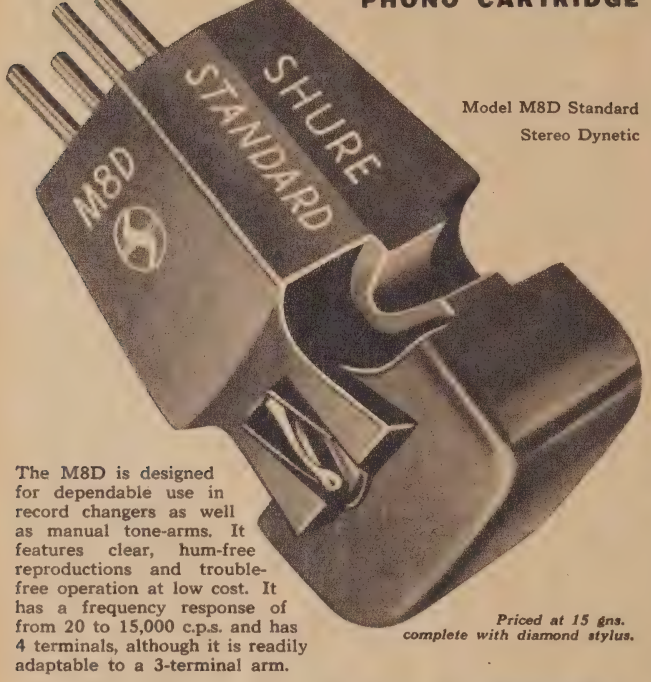

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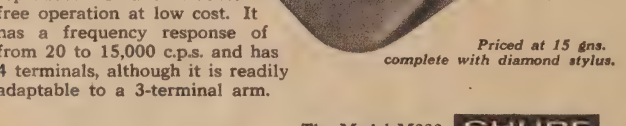

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serve as a vent. A small suppleme vent was provided at the top as sh

Measurement now showed two tinct impedance peaks, one either of the speakers' natural cone reson at about 50 cps and 140 cps.

After listening tests, we decid place a form of acoustic resi across the vent, mainly to limit rad from it of random middle-freq sound, likely to prejudice the fronta tern from the cones. This incr slightly the amplitude of the higher and flattened the lower peak till i barely perceptible.

SERVES ALL SPEAKERS

The "acoustic resistance" used fo purpose was merely a scrap of half thick caneite screwed over the v speaker position and drilled with a tern of ¼-inch holes spaced one apart.

On listening tests, and in this the column showed a fairly level c down to the 140-cycle region, there was a slight prominence bu enough to colour reproduction obje ably. Below 150 cps the level is but output is available to well bel cps. This means that, if desired, di amplifier boosting can be used i lower bass register to produce acoustic output.

At the high frequency end, th sponse is largely a function of th ticular speakers. If routine freq range only is required, ordinary 5 inch single-cone speakers can be preferably with the largest possible nets, in the interests of sensitivity.

In our prototype enclosure, we speakers newly released by the Ro ganisation, namely type 9-6LX, with centre tweeter cones and 1 voice coils. These have basically the sensitivity and bass characteristics normal 9-6L type, but maintain to above 12Kc.

Using these speakers, musical duction from the column is exc with only a lightness in the extrem register to distinguish it from one mal concept of hi-fi sound. Howev behaviour of the column, as des allows boosting to be used in the register with gratifying results.

READILY ADAPTABLE

As mentioned earlier, and acc to Rola engineers, the voice coils ideally be connected in parallel a course, correctly phased so that the all move in the same direction instant.

Thus four 3.5-ohm voice co parallel would present a 0.9 ohm while four 15-ohm coils would p 3.75 ohms. This may necessit turn the use of a matching o transformer to allow the column fed conveniently from a fairly lor

Using four 15-ohm speakers, scribed, we found it practicable nect them in series-parallel to p a convenient total impedance ohms. At this impedance it is practicable to feed the column 15-ohm output transformer via considerable length of plastic lam without line resistance causin noticeable drop in efficiency.

The two upper speakers are co in series, likewise the two lowe the leads being then connected in across the line. Thus two spea series represent 30 ohms, and 3

llel with 30 ohms gives a resultant

efore, it is essential to see that the s are correctly phased. Nowa- anufacturers are normally careful that all speakers of the one type mmetrical in terms of magnet coil polarity, so that correct can usually be obtained by interconnection of the voice coil

ever, phasing can be checked very by touching the input line across olt torch cell and noting that all es move in the same direction for polarity of input voltage.

ne or more happen to be the way around, simply reverse the o the voice coil.

his juncture it may be as well to a few practical hints about the woodworking involved.

most suitable material for the , consistent with cost and rigidity, to be ¼in plywood and, as al- nentioned, we planned the design it could be cut from the popular 3ft size sheet. To provide an ve finish we selected a maple

KING OUT

marking and cutting out of the s straightforward, providing that wing on page 39 is followed and , whether power or hand, is kept line. Some sheets, depending ie manufacturer, are a little over- d this can be distributed over the des, ensuring a minimum of waste al.

ng cut the sheet, opposite sides cabinet can be clamped together G-clamps, veneered side inwards. he edges planed straight and Remember to work from both prevent chipping at the corners. difficulty may be encountered in ng a good straight edge on the des but this can be checked by ng the G-clamps and butting the rresponding edges together. Any pots will be indicated by the of daylight visible between them. can be marked with pencil and es reclamped and planed a little

the front panel can be marked e first step being a centre line from top to bottom. Assuming of four elliptical speakers and les, as already suggested, the open- ay be spaced two inches apart, ree inches from the top of the to the first opening. The latter s to accommodate the vent, which be ¼in deep, after allowing for er decorative moulding is selected. baffle opening for a typical 6 y 9 inch elliptical speaker is 8¼ along the major axis and 5¼ along the minor axis. The method obtain these ellipses was to in- pin at each of the two focal and, using a suitably adjusted f string and a pencil, describing ar elipse.

the aid of a compass, these focal can be obtained by first bisecting ajor axis and drawing a perpen- along which the minor axis is ed. Then with the compass open- to half the major axis and the n one end of the minor axis, de- an arc; the two points at which ajor axis is cut being the oints. Some time could be saved by using a cardboard cutout as a template.

The speaker cutouts were started by first drilling a series of small holes along the waste side of the outline and cutting out with a compass or keyhole saw. Rough edges can be cleaned up with a wood rasp and then sandpapered.

To ensure rigid construction, we decided to use 1 inch by 1 inch dressed batten in the four vertical corners and along the sides at both top and bottom. As seen from the plan drawing, this batten will be screwed and glued in all corners except to the back panel, which is screwed only.

SCREWING UP

The battens are screwed to the sides from the inside and can be prepared by drilling and countersinking clearance holes along one edge approximately 12½ inches apart. The back and front are screwed from the outside and they may be prepared by drilling and countersinking a similar series of holes about half an inch from each edge. Make sure these are suitably staggered so that the screws will not clash.

The job is now ready for glueing and screwing, and it is a good idea to keep the square handy and use it frequently. Once the glue sets there is little chance of correcting mistakes.

Casein glue is a logical choice for this job. It has the advantage of cold mixing, a long setting time which permits unhurried assembly, and excellent strength when dry. The screws used were 1¼in, No. 8 gauge, countersunk head.

With one side placed on a flat surface, two main vertical battens are glued and screwed in position allowing a margin around all four edges equal to the thickness of the plywood. Two small pieces of batten then join the ends of these as shown in the drawings. Tightening the screws will provide sufficient pressure to the glued surfaces. The same routine is followed for the other side.

Next, both the top and bottom of the cabinet can be glued and screwed to the sides, the screws passing first through the clearance holes in the top and bottom battens and then into the top and bottom respectively.

KEEPING SQUARE

To ensure that the cabinet will remain square whilst drying, the front panel can be glued and screwed in position and the back screwed on. The cabinet should then be left overnight to allow the joints to dry and set thoroughly.

Finally, the edges can be planed level with corresponding faces and the whole cabinet sandpapered.

The back panel may now be removed and the speakers mounted in position.

All inside surfaces with the exception of the front panel are then covered with ¼in hair felt, more commonly known as carpet underfelt. A baffle curtain is also draped loosely around the rear of the speakers and tacked in position as shown on the plan drawing.

We planned to cover the front panel with fabric and, to prevent the pattern of the speaker cones being visible through this, the entire panel was given a coat of flat black paint. A dark stain probably would have served the same purpose had it been on hand, but a small tin of blackboard paint proved an economical solution to the problem.

The fabric selected was one of the "Tygan" variety of woven plastic, made by Colan Industries. This material has virtually no adverse effect on the radiated sound, being acoustically transparent to a high degree.

Unfortunately, the length of the column makes it difficult to provide a single strip of material without incurring a lot of waste. However, a few designs are made in 64in wide rolls and we were able to purchase a 1ft-wide strip from one of these. This is just long enough to do the job if handled carefully.

The fabric may be fastened to the panel either by stapling (an office stapling machine does an excellent job) or by glueing. We chose staples, mainly because we felt it might be necessary to remove the fabric if further experiments were warranted.

If it is to be glued the makers recom-

(Continued on Page 59)

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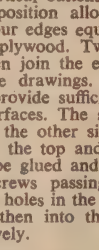

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Further Notes On Narrow Band Filters

In the March and April issues of this year we published details o various narrow-band filters at present in use and the contruction details of a practical 455Kc filter. Since then we have constructed unit on 1,900Kc using toroids and a 455Kc filter designed aroun some miniature "pot cores" made availble by the Ducon organisatio The following is a resume of our findings with these units.

By Keith Jeffcoat

A 1.9Mc filter was constructed in the same size as the original 455Kc unit and with the aid of a sweep generator and direct coupled CRO the following characteristics noted.

The minimum bandwidth consistent with a good shape factor was 6Kc. Increasing the value of coupling capacitors to four times (10pF) the value required for this 6Kc bandwidth will give a passband of 11Kc with an excellent shape factor.

With the 11Kc bandwidth the insertion loss was approximately 24dB while at 6 Kc it was 32dB. This means that the filter would probably have to be used following an intermediate IF amplifier stage, instead of immediately following the mixer, as is usual.

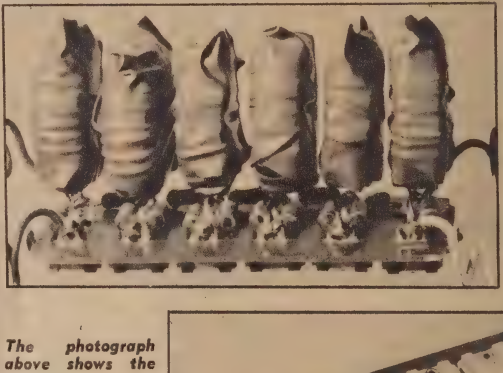
Quite a number of ex-Services and postwar receivers contain main IF channels on or near this frequency and are usually far too broad in their band to give a reasonable perform under the present-day crowded conditions. A not unusual resp curve for such a receiver would be wide at 6dB down and 60 Kc wi 60dB down; a pretty poor shape fa

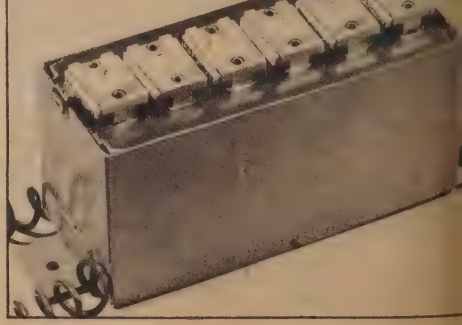
The introduction of a toroid filter such a receiver would decrease the b wid:h to a much more useful value produce a considerably better shape tor. The results could be particu satisfying in the case of some o older receivers which have passban wide as 15Kc at 6dB down.

The circuit and construction of unit is much the same as that desc in the April issue, but a new circ shown (fig. 1) which includes the a values of capacitance necessary for resonance on 1.9Mc.

The coil winding data is as fol L1—14 turns 30B&S, L2 an —19 turns o B&S and L3 t —14 turns o B&S.

If a comparis made between circuit and earlier versio will be seen tha main difference the inclusion additional wi on the first tor provide couplin the plate of t





The photograph above shows the six toroids together with their parallel capacitors mounted on the trimmer lugs while at the right is the unit complete in its brass case. There are five brass partitions inside the case to separate the toroids from each other and prevent capacitive intercoupling.

alve. Coupling from the filter to llowing valve is the same is in evious version.

best results the filter should be aligned as with the 450Kc unit. enerator described in the May issue stable for the job provided the F capacitor from grid to ground 6AC7 reactance tube is changed 00pF. This will ensure adequate ion at 1,900Kc to sweep the whole passband. The oscillator coil be a standard 1,900Kc IF trans-r.

e we published the details on the filter we have had the opportu-install the unit in a wartime Navy er (Marconi CR100) and the results more than lived up to what we ex-from the unit's performance in

strated above is the ferrite ner and ring together with the minium case and ferrite slug d in our new 455Kc filter. ir size can be judged from the rpence placed alongside them.

aboratory. True single sideband elion was possible and, on more one occasion, the unit proved its in eliminating interference on one nd of an AM station.

filter was placed in circuit in the on formerly occupied by the first back-to-back IF transformers and fficulties were encountered in the mounting of the unit. Some re-g of the remaining three IF trans-rs was necessary, as these were rly centred on 465Kc, but this was accomplished with the aid of the ator described in the May issue. In the whole process was completed otal time of 50 minutes.

QUENCY SHIFT

ere is some shift in the centre ency of the filter with temperature rise, though it is by no means s. For best results it is advisable low the unit to come to its nor-perating temperature before align-and particularly before setting the for correct demodulation of SSB missions.

in all, the results obtained have so encouraging that a filter type and transmitter using two of the in cascade is a definite possibility e near future.

e second unit we constructed was forementioned 455 Kc filter using new miniature pot cores, also ob-d from the Ducon organisation. The graph of these units shown along-a sixpenny piece will help to give idea of their size. The aluminium which encases the unit measures

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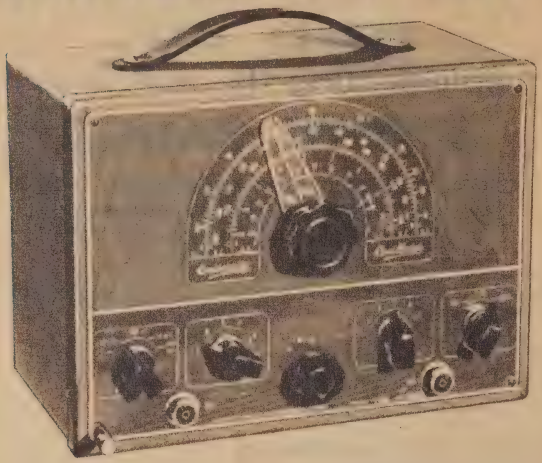

OSCILLATOR MODEL YOA

Model YOA Oscillator is a carefully designed precision instrument which is ideal for Radio Service use, receiver alignment and general experimental work. Finished in grey with black and silver panel, it is of attractive appearance and gives professional standing to any workshop or laboratory. Features such as vernier or fast dial drive, "spot" tuning, RF amplifier stage, new attenuation method, improved shielding, all contribute to make this Oscillator an outstanding University product. Provided with each Oscillator, without extra charge, are valves, shielded output leads, dummy aerial and instruction book.

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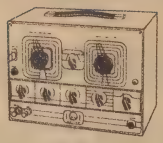
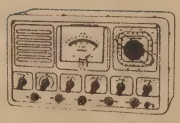
ELECTRONIC VOLTOHMETER TVR/EV
This smartly styled large-scale Electronic Voltohmeter, although designed especially for servicing television receivers, will also test and align A.M. or F.M. receivers, measuring AVC grid bias and screen grid voltage in high-impedance circuits.



TELEVISION ALIGNMENT GENERATOR TVR/SM
This University instrument is the ideal signal source for precision alignment of TV and F.M. receivers. Model SM combines both a precision marker generator and sweep oscillator in one convenient metal case.



SUPERTRACER MODEL AST
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TAS.—W. P. Martin and Company, 188 Collins Street, HOBART, and 134 Cambridge Street, LAUNCESTON.

W.A.—Atkins (W.A.) Limited, 894 Hay Street, PERTH.

UG/F

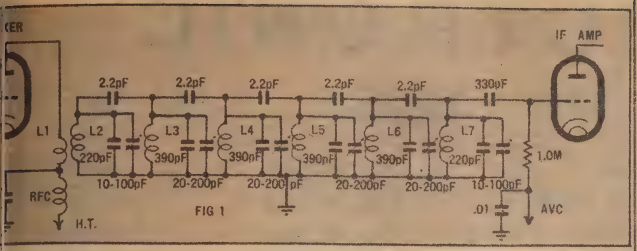

FIG 1

...e circuit above is that of the 1,900Kc unit while that below is the new ...5Kc unit. Basically they are both similar to the original 455Kc toroid filter, but there are some changes which will be noted.

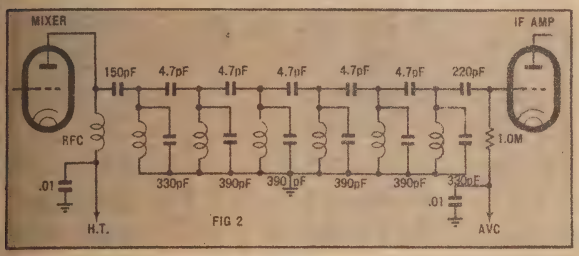

FIG 2

... inch by 7/6 inch and has the ad... ...ng slug screwed into a plastic block ...nted in the top end.

...e ceramic bobbin on which the in... ...ance is wound is at the extreme left. ... attached to a moulded plastic base ...h has five lugs. This allows for the im... ...ance matching tap normally incor... ...ted in transistor IF transformers for ...h the coil former is intended. The ...te ring is placed over the winding ... completes the "potted core" arrange... ...t.

...ix inductors are used in all, each ...ng 80 turns of 5-strand 40 B. and S. ... wire wound on them. No special ...ling arrangement was used, the wire ...g jumble wound. However, it is ...ssary to keep the turns as tight as ...ible, without breaking the litz, other... ... it will be difficult to fit the ferrite ... over the wound core.

...he actual circuit (fig. 2) is the same ...he original 455 Kc filter. Each of ... four centre inductors has a 390 pF ...acitor across it, while the end induc... ... have 330 pF across them. The ...erence allows for the stray capaci... ...e in the input and output circuits.

...Mounting of the inductors was ac... ...plished by drilling six 7-16in holes ...ed ¼in between centres in a piece of ...t brass. Two mounting lugs are pro... ...d on the inductor can and these are ...lered directly to the brass. The

(Continued on page 63)

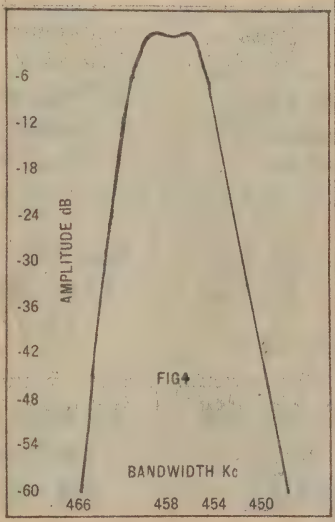

FIG4

This graph shows the bandwidth of the nominal 455Kc pot core filter. The insertion loss is 25dB and the shape factor better than 3 to 1.

...he above illustration shows the completed pot core filter. It is possible ... fit this filter in place of a single ¾in midget IF, with a considerable increase in selectivity.

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12. S/W Conv. (batt.) 2
13. S/W Conv. (A.C.) 1
14. S/W Conv. (A.C.) 2
15. All Wave Conv. 1
16. All Wave Conv. 2
17. 50 Mc/s Conv.
18. 144 Mc/s Conv.
19. Playmaster Stereo Control Unit No. 9
20. Playmaster Stereo Control Unit No. 10
21. Playmaster Mono Control Unit.
22. Playmaster Tuner No. 3
23. Playmaster Program Source.
24. Mullard 3-3 Amp
25. Mullard 5-10 Amp
26. Mullard 5-20 Amp
27. Playmaster 10w
28. Playmaster 17w
29. Mullard 2-2 Stereo
30. Unit 2 Stereo
31. Playmaster 10w Stereo Amp.
32. Playmaster 17w Stereo Amp.
33. 13w PA Amp.
34. 25w PA Amp.
35. 35w PA Amp.
36. 50w PA Amp.
37. 10w Guitar Amp. Std
38. 20w Guitar Amp. Std
39. Transistor 1
40. Transistor 2
41. Transistor 3
42. Transistor 4
43. Transporta 6
44. Transporta 7
45. Transporta (RF) 7
46. Transistor 8
47. Transistor D/W 8
48. Transigram 4
49. Transistor Stereo Amp. 2 watt
50. Transistor Stereo Amp. 4 watt
51. Transistorised Signal Tracer
52. Transistor 10w Amplifier
53. 3" C.R.O.
54. 5" W/Range C.R.O
55. 6 or 12v Tachom'r
56. Wide Range Audio Oscillator
57. Transistorised Wavemeter
58. Sweep Generator
59. G.D.O. Adapter
60. Pattern Generator

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TRANSPORTA 7 Amazing Distance, Volume and Tone £22/15/-	25 WATT P.A. AMPLIFIER £23/12/6	C.D.O. ADAPTER £8/12/6	V.T.V.M. All Ranges Ohmmeter Range 0.1 ohm to 1000 Megohm £24/16/-

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Power ratings are identical with our "Standard" Series Guitar Amplifiers, and both the 10 watt and 20 watt "GOLDEN" Series Kits come complete on an attractive grey Hammertone chassis, with a protective cover. The compact overall dimensions for both units, (11in x 6½in x 7in) allows easy handling for transport. General specifications for each amplifier are listed below.

	10 WATT ("Golden" Series)	**20 WATT** ("Golden" Series)
INPUT SENSITIVITY	60mv.	60mv.
RATED OUTPUT	10 WATTS	20 WATTS
FREQUENCY RESPONSE	± 1db 15CPS — 30KC/S.	± 1db 10CPS — 40KC/S.
HUM LEVEL	74db DOWN	76db DOWN
% DISTORTION	0.6%	0.75%
OUTPUT TRANSFORMER	Grain Oriented Ultra Linear	Grain Oriented Ultra Linear
OUTPUT IMPEDANCES	2Ω — 8Ω — 15Ω	2Ω — 8Ω — 15Ω
INPUTS	High Gain and Low Gain	High Gain and Low Gain
PROVISION FOR TUNER INPUT	YES	YES
TONE CONTROL	YES	YES
EXTRA INPUT CHANNELS	Provision for Two Extra	Provision for Two Extra
VIBRATO	Provision for inclusion	Provision for inclusion
FULL KIT PRICE	**£23/15/-** NETT	**£28/15/-** NETT

A selective adapter is included in the Circuit to allow the various speaker matching impedances to be brought into circuit without effort.

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PART ONE

Our new television receiver with its 23in bonded screen picture tube mounted on the chassis. This particular tube features a 'frittered' screen, designed to reduce incident light reflection. As an alternative method, the tube may be mounted directly in the cabinet.

How To Build The 1961 TV Set

This article is the first of a series describing the construction of our new television receiver. Designed around the latest components, it is intended for use with the new 114-degree 19-inch or 23-inch "square-faced" picture tubes. Using panels to ensure systematic wiring, it is well suited to home constructors or as a project for tutorial classes.

By Alan Nutt

SINCE the publication of our first design, the market position has changed considerably; it may be felt that the description of a TV receiver for home construction is hardly warranted, when the availability of cheap commercial sets is taken into consideration.

However, regardless of all the factors that might seem to militate against the popularity of a receiver for home construction, the fact remains that there will always be the small but important group of readers who like to "roll their own." In addition, there will always be a small but consistent demand for a design to serve as a basis for classes and other tutorial activities.

While not purporting to be the ultimate in design complexity, we nevertheless have endeavoured to present a receiver that will give excellent performance while, at the same time, being relatively simple and cheap to construct.

Basically, there is little difference between the new set and the 1959 model, which has proved so popular with readers. In fact, it was reportedly adopted by several small manufacturers. The most obvious change is the use of a 23in picture tube and associated deflection components, which is in keeping with the current commercial trend.

An almost identical chassis has been used, several holes being added or enlarged where necessary. An extension has been made to the tuner cut-out to permit inclusion of several locally available commercial tuning units.

We have retained the three-stage video IF strip, experience having shown that three stages are adequate in all areas where there is any signal level worth receiving. In fact, with modern techniques, it is rather difficult to make a case for anything more than three IF stages.

The direct coupling between the video amplifier and the picture tube has been dispensed with, AC coupling now being used, with the inclusion of a DC restorer circuit. This arrangement permits full control of the average black level, even allowing for the simple AGC system used. Alternatively, the set can be adjusted for full AC coupling or any intermediate degree of compensation.

Separate sync. amplifiers have been used, permitting both line and frame pulses to be clamped with reduced possibility of intermodulation, with consequent bending of vertical lines.

We spent some time over the vertical deflection stages, finally deciding to retain the blocking oscillator system, but with a difference.

VERTICAL STAGES

Instead of separate oscillator and output stages, the two functions have been combined in the one valve, namely a 6EM7. This valve contains two dissimilar triodes, a high and a low-mu. The high-mu section functions as the oscillator and the low-mu section as the vertical output amplifier.

The combination of both functions in a double triode is reminiscent of our earlier 70 and 90-degree designs. It becomes possible to revert to the scheme in this set, only because of the highly efficient deflection yokes which have become available with the 23-inch 114-degree picture tubes.

We carried out lengthy tests on a different type of oscillator circuit, involving the 6EM7, but using the phase shift principle. The advantage of this circuit is that it does not require the use of a blocking oscillator transformer, but it does use more small components than the final design, involving both cost and complexity.

Horizontal deflection, audio system and power supply are similar to the 1959 receiver but the facilities for remote control are built in, rather than being treated as modifications. Whether you actually build a remote control unit or not is a matter for yourself.

While on the subject of remote control, we looked into the possibility of remote channel selection and more will be said of this later.

This month we will only consider in detail the sections of the receiver concerned with the reception of the sound channel. This will include the power supply, audio amplifier, ratio detector and sound IF channel. In addition, the video amplifier, video IF and tuner must be discussed, as they play a vital part in the reception of the sound as well as the picture information.

Considering the sections in the order in which they are mentioned in the previous paragraph, it will be observed from an examination of the schematic that the

type GW4500. Other tuners could be substituted with slight variations in the HT supply circuit. Home-made or simplified tuners can not be recommended for any but strong signal areas.

NOTE: VIDEO IF AMPLIFIER

The circuit as shown is for the Q-Plus Mark V prefabricated and prealigned IF strip. It may be built up, alternatively, from individual components. Other types of IF strip may be substituted but may require a larger HT dropping resistor.

NOTE: SOUND IF AMPLIFIER

Components to be assembled and wired on main chassis. Sound IF may alternatively be part of a composite Video Sound IF strip, or use two sound IF stages where such are provided or desired.

SFD106, GEX34, OA79

SFD106, GEX34, OA79

ary must be phased to give negative feedback. Feedback constants as given are suitable only for nominal 2 to 3 ohm voice coils.

SPEAKER V C TERMINALS

REMOTE CONTROL

+190V

6FQ5 6CG8-A

VIDEO IF AMPLIFIER

6CB6 6CB6 ½6U8 OA79, GEX34, SFD106

AERIAL

TUNER (Q-Plus GW4500)

FRAME EARTHED BY BOLTING TO MAIN CHASSIS

OA79 GEX34, SFD106

½6AW8

CATHODE OF PICTURE TUBE

+250V

500 CONTRAST

VIDEO AMPLIFIER

IN2094, IN1763, OA210

POWER SUPPLY

SYNCH. SEP.

VERT. SYNCH. AMPLIFIER

VERT. OSC.

VERT. OUTPUT

VERT. DEF.

DC REST.

PICTURE TUBE GRID

HOR. SYNCH. AMPLIFIER

SYNCHROGUIDE & HOR. OSC.

HOR. OUTPUT

HOR. DEF.

EHT SUPPLY

15KV

CIRCUIT NOTES

1. All capacitor values are shown in microfarads, unless otherwise marked.
2. Where not otherwise marked, capacitors can be 200 to 400 volt types, depending on the position in circuit.
3. All resistors are half-watt unless otherwise marked.
4. All resistor values are shown in ohms unless otherwise marked. (M—Meg. K—x1000).
5. Voltages are as measured in prototype chassis, using standard tolerance not design centre components.

1961 TELEVISION RECEIVER (PART 1)

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Phone BW 6991

power supply is the now conventio voltage doubler type, employing silic power diodes as the rectifier elements

The current ratings of both the pow transformer and filter choke are m than adequate for the heavy load enco tered in a receiver of this size. There sufficient reserve to permit the inclus of a second 6BM8 in the audio sect should individual constructors have pansive ideas.

Both power transformer and choke readily available on the market, seve manufacturers having made models av able for our 1959 TV receiver. A cer tapped 12.6 volts heater winding is p vided, the centre tap being ground thereby effectively providing two 6. windings, each with one side ground

DECOUPLING

The various stages throughout the ceiver are adequately decoupled, as q an appreciable amount of interaction take place through the common po supply impedance if these precauti are not taken. The 200 mfd filter ca citor on the main HT line is import to the end result.

Coming now to the audio section 6BM8 triode pentode is used as a c bined voltage and power amplifier. T arrangement follows quite standard p tice and requires little comment.

A feedback loop is provided from speaker transformer secondary back the cathode of the voltage amplifier, constants being chosen for use wit 2 to 3 ohm speaker. Suitable modif tions will have to be made to both feedback resistor and shunt capacito alternative speaker impedances are u Thus for a 15-ohm speaker the resi would need to be increased to 6 or 7500 ohms and the capacitor to .0 mfd.

Remember, of course, that the f back must be phased to produce n tive feedback, indicated by a reduc in the initial gain of the audio ampli

In our earlier models, the spe transformer used was of open const tion and, in some instances, it was ne sary to orient the transformer with spect to the vertical output transfor mounted close by. This operation necessary to reduce frame buzz in loudspeaker, due to direct pickup the speaker transformer.

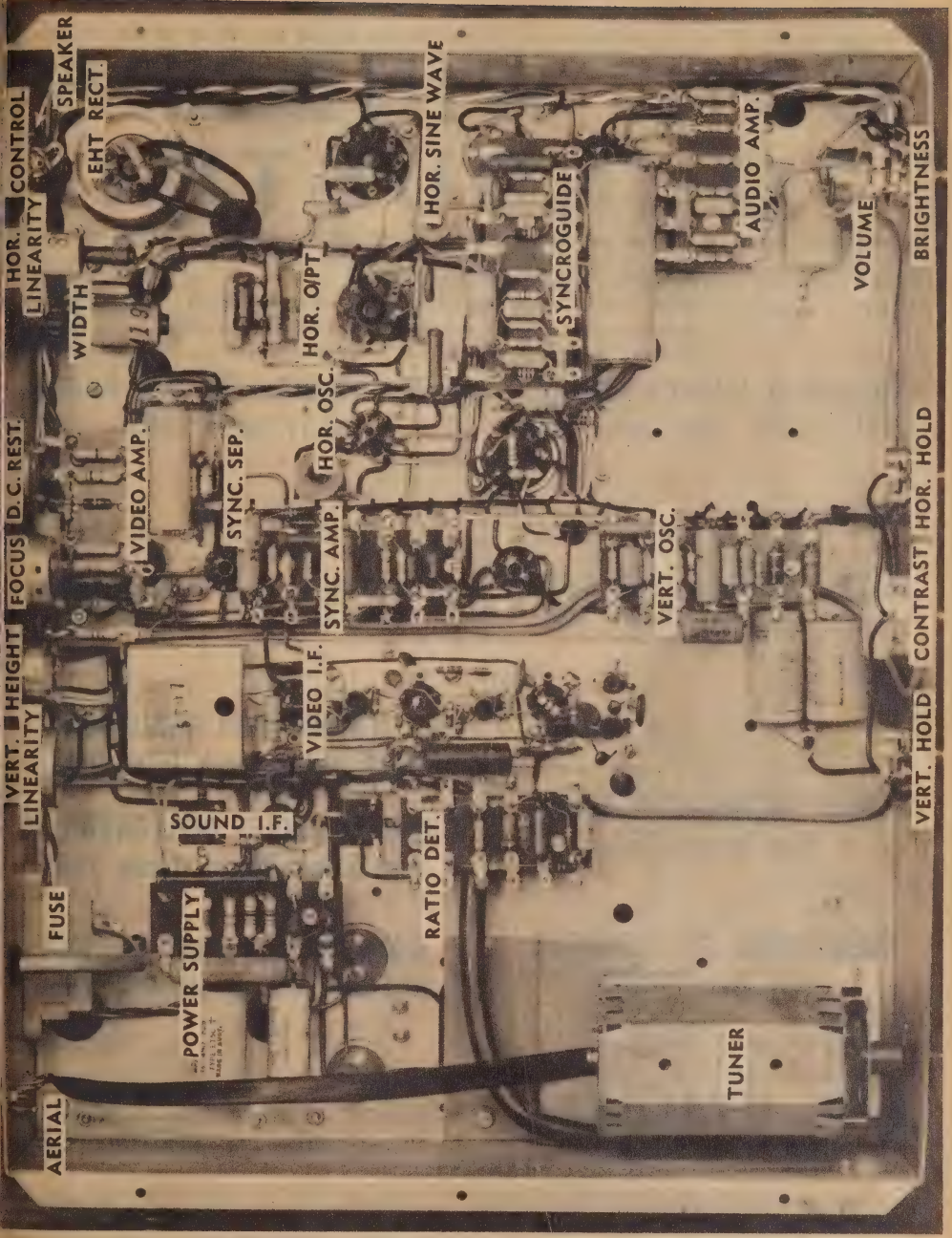
NO FRAME BUZZ

In this model we have used a c pletely enclosed speaker transformer there has been no sign of frame buz the audio output. This is due, in also to the lower signal level enc tered in the vertical output stage wh in this case, uses a triode valve ins of a power pentode.

The ratio detector and sound IF plifier may logically be considered gether. Again, conventional prac has been followed by the use o matched pair of germanium diode the ratio detector circuit. Unless ma ed diodes are used, it may not be sible to obtain a completely symm cal "S" curve when aligning the detector and, for this reason, it is a able to ensure that the diodes are bo as a pair.

A 6AU6 is used as the 5.5 Mc s IF amplifier, its grid circuit being t by a single transformer winding, ca tively coupled to the plate of the v amplifier valve.

The remainder of the circuitry t described has functions common to



This underneath photo shows the clean layout and the free use of component panels.

und and vision signals. For this rea-
n, much of the complexity in these
ages is due to the wide band widths
d extended frequency response neces-
ry for the handling of the high fre-
ency video components.

The video detector and amplifier
ages are examples of the additional
rcuitry required to correctly handle
e video signals. The 6AW8-A operates
a wide-band amplifier with compen-
sating chokes in the plate circuit. The function of these chokes, in conjunction with the low plate load resistor (4.5K) is to extend the frequency response to something in the vicinity of 4 Mc.

Also in the plate of the video amplifier is a series circuit tuned to 5.5 Mc. This trap has two functions, firstly to provide a "take-off" point for the 5.5 Mc. sound IF channel and secondly to prevent sound signals from modulating the picture. In a more or less "accidental" fashion, it happens to improve the video passband below the 5.5 Mc. rejection frequency.

Some receiver designs take the sound carrier from the output of the video detector, but it is possible to realise an appreciable increase in sound carrier gain by first passing it through the video amplifier and taking it from the "hot" side of the sound trap, as we have done

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PROGRAMME SOURCE FOR UNIT STYLE CASE, April Issue 1961

7151	Aerial Coil lug mount	9 10
7304	Oscillator Coil lug mount	9 10
119	I.F. Transformers each	16 6
3293	Power Transformer	40 6
R1189	Chassis, terne plate, completely punched.	25 0

Including Tax and Postage.

LITTLE GENERAL FOR 1961 March and April Issue 1961

718	Ferrite Loopstick Aerial. Special price at	17 6
7304	Oscillator Coil lug mount	9 10
119	I.F. Transformer lug mount	16 6
3293	Power Transformer	40 6
4101	Speaker Transformer	15 9
R1179	Chassis, terne plate, completely punched	26 0
	1 meg. Potentiometer plus switch	7 0

Including Tax and Postage.

SWEEP GENERATOR 455KC May Issue 1961

7315	Oscillator Coil	15 6
3294	Power Transformer	40 6

Including Tax and Postage.

ELECTRONIC STETHOSCOPE July Issue 1961

4305	Audio Output Transformer	21 0
5202	Audio Driver Transformer	21 0

Including Tax and Postage.

ALL TRANSISTOR CAR RADIO July Issue 1961

7103	Aerial Coil	16 0
7200	R.F. Coil	16 0
7300	Oscillator Coil	16 0
9100	I.F. Transformer	17 6
5201	Audio Driver Transformer	18 6
4304	Audio Output Transformer	18 6

Including Tax and Postage.

1961 R/TV & H TV RECEIVER

3209	Power Transformer	7 7 8
8104	Choke	1 2 8
4407	Vert. Output Transformer	2 1 6

For other TV Components, e.g., Coils, Transformers, peaking chokes, etc., please state your requirements.

2 TRANSISTOR HEADPHONE RECEIVER. March Issue 1961

7104	Loopstick Aerial	17 6

NEW TV SWEEP GENERATOR 36 and 5.5mc March Issue 1961

3293	Power Transformer	40 6

Including Tax and Postage.

COMPACT SIX BAND SERVICE OSCILLATOR. September 1960

	Set of 6 Coils; bands A to F	72 0
	Line Filter Chokes each	8 6
	Audio Freq. Osc. Transformer	17 6
	Power Transformer	37 6

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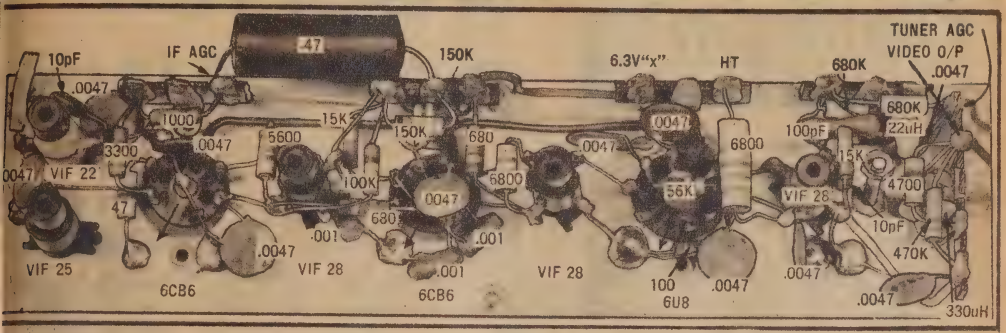
WIRING DETAILS OF THE PREFABRICATED I.F. STRIP



If you elect to wire up your own video I.F. strip, it should look like this, with sockets suitably orientated, active leads kept very short and capacitors close to the points which they are intended to bypass The shield over the video detector has been removed for the photograph.

this instance. In practice, no compli-itions ensue.

The video detector consists of ger-anium diode designed for video detec-r application. Series and shunt peak-ng chokes are placed in the output of e detector in order to improve the ideo frequency response.

An AGC voltage is obtained from the ideo detector in much the same man-er as AVC voltage is developed in a mple broadcast receiver. This control oltage is applied to the control grids f the IF amplifier valves. A second iode is used to provide an additional GC voltage for application to the RF mplifier in the tuner, this voltage being f a suitably higher order.

As mentioned before, a prefabricated F strip was used in our own receiver nd, as such, considerably simplifies the onstruction. At the same time, the strip also pre-aligned, which is of import-nce to those who may not have imme-iate alignment facilities available.

REGENERATION EFFECTS

On the other hand, there may be ose who, for one reason or another, esire to construct their own IF chan-el. For the benefit of those so inclined, e have included a detailed photograph f the layout which should be closely dhered to if instability is to be avoided.

Even if an IF strip is not actively un-able, regenerative effects prevent the roper response curve being obtained, hen alignment is attempted, or main-ined over a range of bias values.

Looking at the IF channel in detail, consists of three stages of amplifica-on suitably stagger-tuned and resist-nce-loaded to obtain the required re-ponse pattern. The first two stages use CB6 pentodes, series connected. A ving in current drain is effected, volt-ge regulation is improved and less wat-ge is wasted in dropping resistors.

The third stage uses the pentode sec-on of a 6U8. We used the triode sec-on in a DC restorer circuit, which will e described later.

The entire assembly is assembled on a b-chassis which is mounted in a cut-ut provided in the main chassis. The arious connections necessary are made tag strips located along the edge.

The choice of a tuner for the receiver left open to the individual construc-r, as quite a number of commercial units are currently available. During the course of our experiments we checked a variety of tuners, including the original Q-Plus tuner, Mullard, Philips, Admiral, and Ekco. all with satisfactory results.

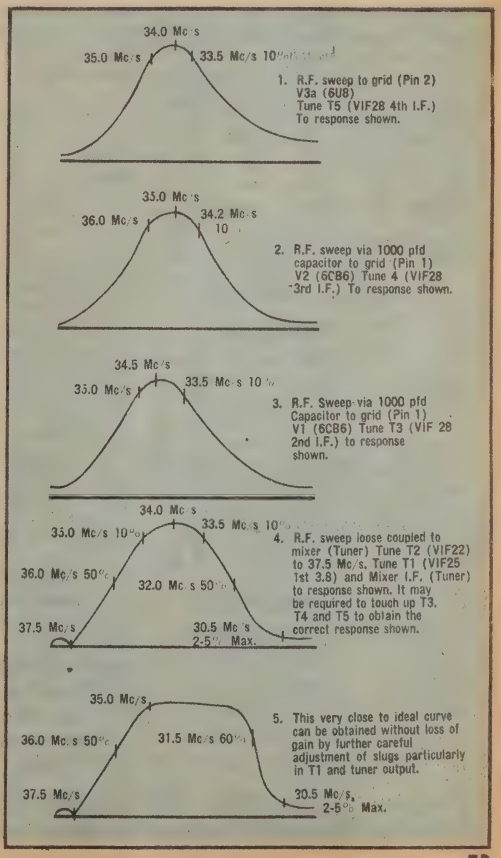
The tuner shown in the photographs is a 13-channel Q-Plus model, GW 4500. This tuner is very small physically, despite the inclusion of the additional channels.

The circuitry follows the "neutrode" rather than the more or less conventional "cascode" pattern, having a single neutralised triode ahead of the mixer stage. The triode valve is of distinctive construction, employing special plates between the grid and the anode, thereby reducing the grid-plate capacitance and at the same time clearly defining the path of the electron flow. Comparable results are thereby obtained with greater circuit simplicity.

☆

The first four curves have been copied directly from the manufacturer's data for the Q Plus Mark V IF strip. The final curve we were able to obtain by further careful adjustment of the slugs, particularly T1 and tuner output and also by attention to the matching between tuner and IF strip.

During the tests on the tuners, we found a wide variation in the output impedance between tuners of different manufacture. These differences, while possibly not in themselves important, must nevertheless be taken into consideration when it is desired to match a particular tuner into a given IF channel, having a fixed input impedance. We will have more to say on this point when considering the alignment details.


34.0 Mc/s
35.0 Mc/s
33.5 Mc/s
1. R.F. sweep to grid (Pin 2) V3a (6U8) Tune T5 (VIF28 4th I.F.) To response shown.
35.0 Mc/s
36.0 Mc/s
34.2 Mc/s
2. R.F. sweep via 1000 pfd capacitor to grid (Pin 1) V2 (6CB6) Tune 4 (VIF28 3rd I.F.) To response shown.
34.5 Mc/s
35.0 Mc/s
33.5 Mc/s
3. R.F. Sweep via 1000 pfd Capacitor to grid (Pin 1) V1 (6CB6) Tune T3 (VIF 28 2nd I.F.) to response shown.
34.0 Mc/s
35.0 Mc/s
33.5 Mc/s
36.0 Mc/s
32.0 Mc/s
37.5 Mc/s
30.5 Mc/s
2-5% Max.
4. R.F. sweep loose coupled to mixer (Tuner) Tune T2 (VIF22) to 37.5 Mc/s. Tune T1 (VIF25 1st 3.8) and Mixer I.F. (Tuner) to response shown. It may be required to touch up T3, T4 and T5 to obtain the correct response shown.
35.0 Mc/s
36.0 Mc/s
31.5 Mc/s
37.5 Mc/s
30.5 Mc/s,
2-5% Max.
5. This very close to ideal curve can be obtained without loss of gain by further careful adjustment of slugs particularly in T1 and tuner output.

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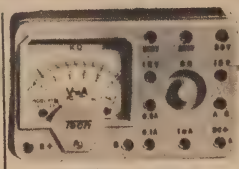

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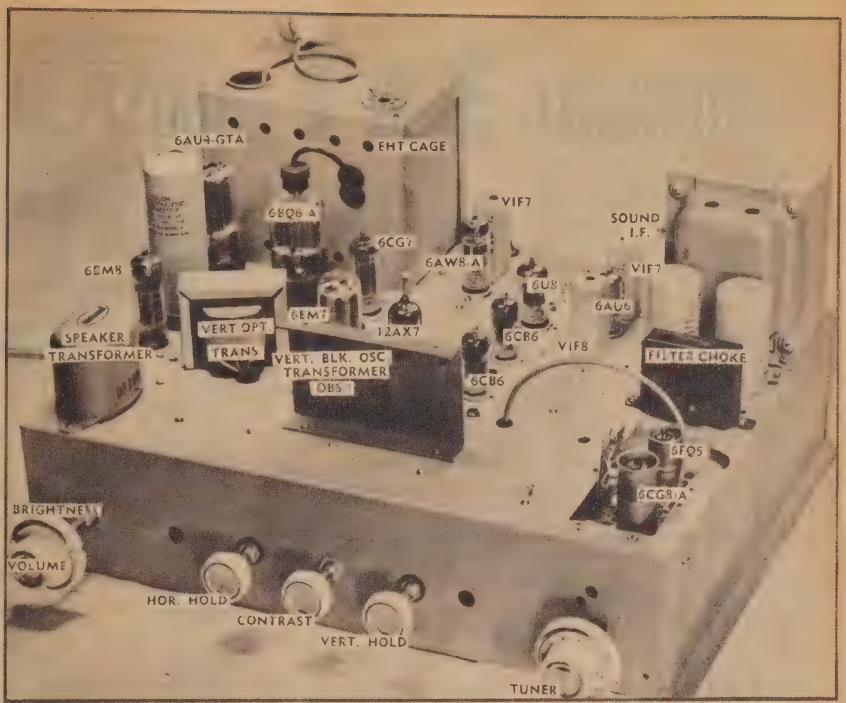


This top chassis photo, with the picture tube removed, gives a clear idea of the layout of the major components and valves. Note the extended cut-out to permit the use of a variety of tuners.

☆

We come now to he actual construc- ion of the receiver. o avoid possible omplications, the iring and layout hould follow close- y our prototype re- eiver. This will be ssured to a large egree by using the ame system of anels and com- onent layout. The osition of actual eads is not critical or the most part, ut avoid lengthen- ng those leads hich carry high requency signal.

As an aid to uniformity in construc- on, the majority of the smaller com- onents have been assembled onto panels hich, in turn, are mounted on one- ch moulded stand-off pillars to the ain chassis. Detailed layout diagrams f these panels are included, so that they ay be duplicated exactly.

We suggest that, before commencing e assembly work on the main chassis, e panels be completed and put aside ntil required.

ANEL ASSEMBLY

The assembly of the components on to e panels should present no difficulty. he width of the tag strip may be im- rtant in some positions where space at a premium. The material we used easured approximately 1 1/8in across, cluding the lugs.

It is a wise procedure to tin the leads all components before placing on the rips, at the same time remembering to ave sufficient length of lead to be grip- d by a pair of pliers when actually ldering to the panel. This latter pre- ution is necessary to prevent possible at damage to the small components, rticularly resistors. Do not solder rd against the basic component.

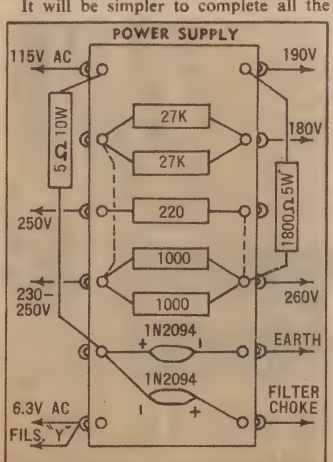
We suggest that assembly on the main assis be commenced by mounting all cessary valve sockets in their ap- opriate places, followed by the power ansformer, filter choke, electrolytics and eaker transformer.

The valve sockets should be mounted ith the pins oriented as indicated in the otographs. In some instances, the lationship of the pins to the mount- g holes will be found to vary with e make of socket. In such instances, will be advisable to drill new mountings les (assuming a pre-punched chassis) ther than re-route critical wiring.

The IF strip, if purchased as an assembly, may be mounted also but if it transpires that further drilling of the chassis becomes necessary after the strip is mounted, it is a wise precaution to remove it again, as excessive vibration may easily shift the position of the slugs in the IF transformers and completely upset the alignment.

After mounting the major components onto the chassis, the heater and HT wiring may be commenced. The heater lead from each of the sections described this month should be connected to the side of the heater winding on the power transformer marked "X," while the remaining valves associated with the deflection circuitry are connected to the other end of the winding marked "Y" in the circuit diagram.

It will be simpler to complete all the heater wiring and run HT leads even to the sections that are not yet in use, rather than try to add leads to an existing cable form at a later date. To this end, the necessary HT supply sources and voltages have been marked on the circuit diagram for the stages to be included later.



In wiring the power supply section, the relevant panel should be mounted in position and spaced from the chassis by suitable tubular spacing pieces. In our case we used short lengths of polystyrene tubing, although they could just as well have been made of brass or some other material.

The power lead is brought through the rear wall of the chassis and both active and neutral leads terminated on the drawer-type fuse block. An insulated lug is provided in the centre of the block for terminating the neutral lead, the active lead connecting to one end of the fuse mounting.

POWER LEADS

From the neutral lug and the free end of the fuse, a pair of leads should be run around the edge of the chassis to the power ON/OFF switch at the rear of the volume/brightness control, connecting thence to the transformer primary winding.

The audio amplifier section is the next logical section to wire up. Complete all necessary earth wiring around the 6BM8 socket and then mount the audio panel in a similar fashion to the power supply panel, using the photographs to obtain correct orientation.

As mentioned earlier, it will be necessary to correctly connect the speaker output transformer in order to provide the correct phase relationship for the negative feedback loop. Output transformers are commonly colour coded with the primary leads red and blue,

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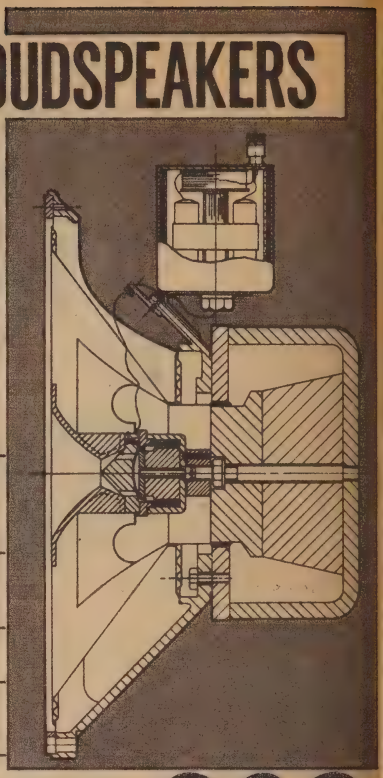

General Specifications

Frequency Range: 30 — 20,000 c.p.s.
Impedance: 15/16 ohms.
Coil Diameter: 3" Bass and Mid-range
1" (Aluminium) H.F. Pressure Driver
Electrical Crossover: 5,000 c.p.s. twin half section L.C. network 12 db/octave
H.F. Balance Control: constant impedance wirewound L-pad, 0-15 db.

TYPE	SIZE	POWER HANDLING CAPACITY	FUNDAMENTAL RESONANCE	MAGNET WEIGHT	TOTAL FLUX	BAFFLE HOLE	¼" BOLT CIRCLE DIAMETER
412	12	20 watts	35	3½ lbs.	240,000	11"	11¾"
415	15	20 watts	25	3½ lbs.	240,000	13"	14 9/16"
615	15	25 watts	25	6 lbs.	308,000	13"	14 9/16"

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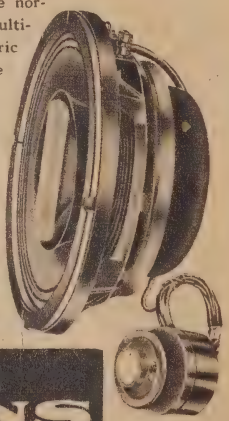

SPECIFICATIONS

Frequency Range: 40 — 20,000 c/s.
Fundamental Resonance: 45 c/s.
Max. Power Handling Capacity: 10 watts, 20 watts U.S.A.
Total Flux: 178,000 Maxwells
Voice Coil Diameter: (Bass and Mid-range) 3"
Voice Coil Diameter: (H.F.) 1"
Impedance: 15 ohms at 400 c/s.
Baffle Hole Diameter: 7"
Mounting: 4 holes, 9/32" diameter on 7⅛ P.C.D.

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nd the secondary leads green and
lack.

Assuming standard practice, the red
rimary lead should be connected to the
IT supply while the black secondary
ead should be the one connected to
arth. This will normally give correct
hasing the first time up. Unfortunately,
hs colour relationship may not always
old good, but it is nevertheless a simple
natter to reverse the secondary leads if
he amplifier oscillates violently when
witched on.

If it is desired to check the functions
f the audio section when completed,
he HT supply voltage will have to be
djusted as, with only a light load, the
oltage will be considerably higher than
ormal. We suggest that, as a tempor-
ry measure, the 5-ohm resistor in series
vith the transformer and rectifier diodes
e increased to something in the order
f 50 ohms.

THE RATIO DETECTOR

Providing the stage is functioning cor-
ectly, it should be possible to obtain a
ealthy hum from the speaker by plac-
ng a finger on the "hot" lug of the
olume control.

The ratio detector and sound IF are
ext in order, the photograph showing
he necessary layout details. The audio
ead from the output of the ratio detec-
or to the volume conrol and also to the
emote control socket should be run in
hielded cable to prevent hum and frame
uzz pickup. The 6.8 coupling capacitor
rom the plate pin of the video amplifier
o the grid of the 6AU6 IF amplifier is
nounted on a two lug tag strip adjacent
o the video amplifier valve socket.

Construction of the video amplifier
hould closely follow the pattern of our
rototype, as any additional stray cap-
citance introduced into the circuit will
pset the frequency response. All leads
arrying high frequency signal should
e kept short and direct and, at the same
ime, spaced away from the chassis.

The coupling capacitor from the out-
ut of the video amplifier to the cathode
f the picture tube is mounted on the
ideo panel but should not be allowed
o lie against the rear edge of the chas-
is when the panel is placed in position.

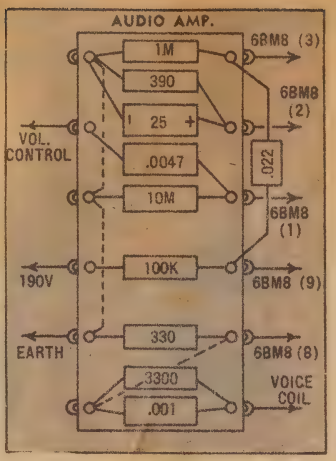
The lead from the cathode of the
AW8 to the contrast control located on
he front of the chassis must be run in
ow capacitance coax. The shielding
minimises stray signal pickup or radio-
ion, while the capacitance must be small
o as not to upset the high frequency
oost obtained from the cathode circuit.

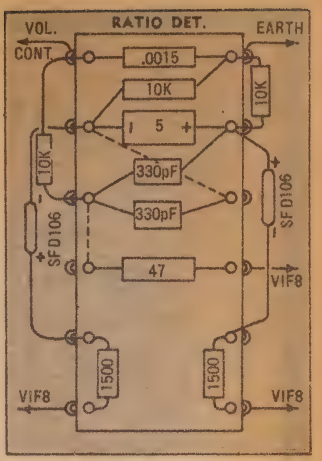
Passing to the video IF sub-assembly,
eater and HT connections are made to
ag strips located along the side adja-
ent to the sound IF channel. The out-
ut from the video detector as well as
he AGC bias for the tuner is taken
rom a tag strip mounted underneath
he shield covering the detector circuitry.

COVER MODIFICATION

The cover shield over the video detec-
or may be modified slightly to permit
asier access to the components and tag
trip underneath. As supplied, the cover
s soldered to the sub-chassis of the video
F strip. The soldered connections
hould be removed and a hole drilled
hrough the top of the cover and the
hassis underneath, taking care to keep
vell clear of any components.

A long bolt should then be passed
hrough the chassis from the top side
nd locked in place with a nut and
tar washer. The shield may now be slip-



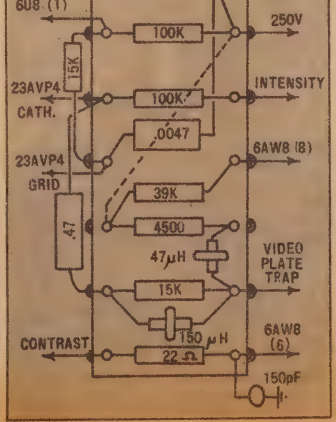


ped over the bolt and held in place with another nut. It then becomes a simple matter to remove the cover to make connections to the tag strip or replace any components underneath.

Input connection to the IF strip is made to one of the lugs on the side of the adjacent channel trap, VIF22. This lead from the tuner should be coax. cable once again, in order to minimise losses at the high frequency involved.

Finally, the tuner may be placed in position and the necessary leads connected. Both the mounting arrangements and the terminating of the supply leads will depend on the type of tuner used. The original cutout in the chassis has been extended almost to the front edge of the chassis to permit the various types to be easily mounted, and at the same time, leaving sufficient room behind the tuner for the possible inclusion of a remote tuning unit.

The Q Plus tuner shown in the photographs required the use of two small "L" shaped aluminium brackets to mount it in the cutout. For a Philips or Mullard tuner, we mounted a plate near the bottom of the chassis and sat the tuner on it. The Ekco, Admiral and earlier model Q Plus tuners may be bolted directly to the chassis without the need for additional metalwork.



Some tuners provide tag strips for terminating the leads, while others use special types of feedthrough capacitors with a terminal lug at one end for connecting to the supply leads. Whatever the method adopted in the particular tuner being used, do not forget to include the .47 mfd AGC bypass capacitor right at the tuner AGC terminal.

This now completes all the assembly necessary for the reception of the local TV sound channels. After carefully checking the wiring, the set may be switched on and without further adjustment, apart from attaching a random length of wire to act as a temporary aerial, it should be possible to tune all three of the local station sound carriers.

ALIGNMENT NECESSARY

The foregoing, of course, assumes the use of a pre-aligned video IF strip. If, on the other hand, the IF channel has been constructed at home, using the component parts, it may well be that the alignment is sufficiently far out of adjustment to prevent satisfactory reception being obtained.

In any case, but more particularly in the latter instance, it may be well worth while at this point to carry out a complete alignment of both the video and sound IF channels. However, if a pre-aligned video strip has been used and immediate facilities are not available, alignment of the sound IF may well suffice for the time being.

In no circumstances should the slugs of the IF transformers be indiscriminately 'twiddled.' Even if a complete alignment is contemplated, random movement of the cores makes for unnecessary wear.

We must mention again that alignment of the video IF channel can ONLY be carried out satisfactorily using the correct equipment, namely a sweep and marker generator and an oscilloscope. If such equipment is not available or you do not feel competent to tackle the job, we strongly suggest you contact some firm who will be willing to carry out the alignment for a small fee.

The necessary alignment data, reproduced from the manufacturer's specifications, has been included for the Q Plus Mk. V strip. If the information given is carefully followed, it should be possible to reproduce the curve indicated at the bottom of the diagram. However, one

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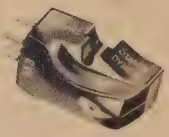

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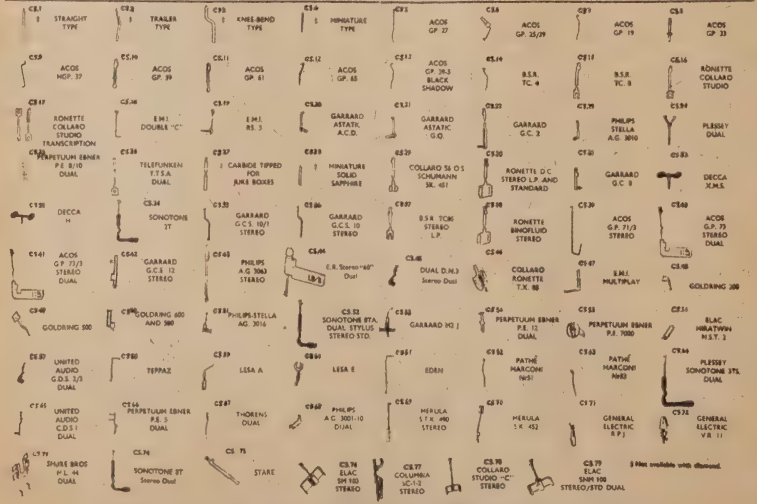
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CS.5 ACOS GP 27
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CS.10 ACOS GP. 39
CS.11 ACOS GP 61
CS.12 ACOS GP. 65
CS.13 ACOS GP. 39-3 BLACK SHADOW
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CS.15 B.S.R. TC. 8
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CS.17 RONETTE COLLARO STUDIO TRANSCRIPTION
CS.18 E.M.I. DOUBLE "C"
CS.19 E.M.I. RS. 3
CS.20 GARRARD ASTATIC A.C.D.
CS.21 GARRARD ASTATIC G.D.
CS.22 GARRARD G.C. 2
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CS.30 RONETTE D.C. STEREO L.P. AND STANDARD
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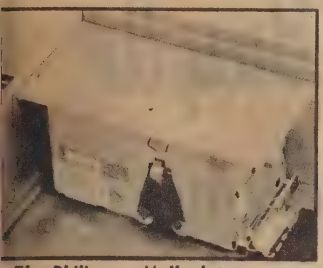
MOST TYPES ARE AVAILABLE WITH DIAMONDS

mportant point must be borne in mind. When we came to carry out alignment n our prototype receiver, we were un- ble, at first, to achieve the required re- ponse curve. The trouble was eventu- lly traced to an impedance mismatch etween the tuner used and the IF strip.

Trying both a new Philips tuner and he Q-Plus neutrode tuner, using link



The Philips or Mullard tuners are best mounted by bolting them to a supplementary platform, as shown.

oupling in both cases, we found it vir- ually impossible to achieve anything like he required flat top on the response urve. In both cases, the slug in the uner IF had to be screwed right out of he former and even then the results vere extremely poor.

It was fairly obvious that quite a deal f mismatch was present between the uner and the IF strip so we set about o make some alteration to the input mpedance of the IF strip, this being bout the most logical and accessible pot.

The 10 PF capacitor connected be- ween the cold end of the first IF and arth was increased to 100 pF, thereby owering the input impedance and en- bling us to obtain a response curve vhich, while not a text book copy, was, evertheless, well within accepted limits.

Changing this capacitor has negligible ffect on the tuning of the first stage, the capacitor" having most effect being the nput capacitance of the 6CB6.

The neutrode tuner also has provision or capacitive coupling and on trying his method with the IF strip in its riginal condition we found the results ery similar to the link coupling with he modified input impedance. Unfor- unately, no provision has been made on he Philips and Mullard tuners for capac- ive couplings, although it would be pos- ible to re-arrange the wiring in the uner to bring this about.

OTHER TUNERS

We also checked an Admiral tuner, btained through disposal sources, and mploying capacitance coupling to the IF rip. The results were identical with hose obtained using capacitance coupl- ng from the Q-Plus neutrode circuit.

Of the tuners tested, the Q-Plus tuner sed with our 1959 receiver provided the est overall response curve, due to a ery good match between the tuner and he IF strip. This particular model, while sing link coupling, provided a much igher impedance in the link winding, losely approximating the input imped- nce of the IF strip.

The sound IF channel alignment may e satisfactorily carried out using nothing ore elaborate than a VT voltmeter and a television signal from a local station.

The signal level to the receiver should be reduced to a low level by using a very short length of aerial. The VT voltmeter should be set to the 3-volt DC scale and the pointer brought to the centre zero position.

Attaching the meter to the audio output lug on the ratio detector panel will most likely cause the pointer to deflect either side of the zero point. Bring the pointer almost back to centre zero by means of the zero control knob.

The slug in the video amplifier plate trap should now be adjusted and the meter watched for any increase in deflection, indicating an increase in signal level. It should be possible to find two peaks as the slug, is screwed right through the trap coil and out the other side. If only one peak is in evidence, it may be assumed that the coil is not tuning to 5.5Mc, in which case a few picofarads of capacitance may be added to the 30pf capacitor already across the coil.

Leave the plate trap adjusted to one of the peaks and try to obtain a similar peak in the IF transformer in the grid circuit of the 6AU6 and also in the primary, or bottom slug, of the ratio detector coil. Finally, the secondary or top slug of the ratio detector coil should be adjusted to bring the pointer to the centre zero position, indicating exact balance.

Next month, we will describe in detail the deflection and synchronising circuitry so that the picture information may be added to the sound channel now in operation.

(To be Continued)

COLUMN SPEAKER

(Continued from Page 41)

mend a PVC type glue which dries colourless and is slow enough to allow the fabric to be straightened and adjusted after it is fitted.

If a single 64in strip cannot be obtained, two 3ft lengths will have to be employed, with the centre join masked by an extra strip of moulding as used for the edges.

The moulding chosen for the edges is supplied with a gold bead which is fitted to a centre groove. It was attached by using 1¼-inch panel pins nailed into this groove, the heads driven home, using a piece of sheet metal as a punch.

The gold bead was then mitred, using a fine file, and temporarily placed in this groove, concealing the nails. A more permanent job can be made after staining.

After a fine sanding the cabinet can be stained and polished. Because of the light shade of the fabric used, it was decided that the inside half of the moulding remain the natural wood colour, being close to that of the fabric, and the outside half of the moulding stained to blend with the darker shade of the veneered plywood. Thus the gold bead provides the break between the two shades.

In conclusion, here's a brief note for those who may want to use five oval speakers. Rola 9x6 LX speakers are assumed with a cone resonance in the 85-cycle region.

Provide the vent at the top as specified for the four-speaker arrangement. Draw pencil lines, one down either side of the front baffle and along the bottom, just clear of the speaker frames. Mark off and drill 3/16 holes at 1-inch intervals along these lines, making about 120 holes in all. This provides the necessary extra venting. With five speakers, a series-parallel voice coil system becomes less attractive, though it would be possible to parallel the outer speakers and connect them in series with the centre one; the other two, in series, could connect across this.

The preferred system, however, would be to connect the voice coils in parallel, using an auto transformer to suitably raise the impedance.

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Let's Buy An Argument —ABOUT EXPLOSIVES

You may recall that, in the May issue, we published a letter from a reader suggesting that we should have laid greater stress on safety precautions in a particular article. While we did not entirely agree with his remarks, the letter did emphasise to all concerned the importance of that very excellent phrase "safety first."

AS an illustration of the above, I subsequently received a letter from a reader, properly identified and signed, but who rather understandably wished to remain anonymous, even to the omission of his initials. He is an active amateur and apparently wishes to be able to converse on the air on subjects other than his admitted faux pas! He says, and I quote:

"You recently published an article dealing with safety precautions in electrical gear.

"I feel that the article enclosed should receive greater publicity. Only two weeks ago, I unthinkingly parked a package of electrical detonators on a shelf below my amateur transmitter; alongside them were several sticks of blasting powder. The transmitter was used in the normal way—and I feel lucky to be alive today.

"The fact that nothing blew up was probably due to the connecting wires of the detonators being tightly rolled in small coils, as supplied by the manufacturers.

"Until reading the article in question, the possibility of RF initiating an explosion had never occurred to me."

(Name and initials withheld)

Perhaps I'm old fashioned, or cautious or something, but I can't imagine myself leaving detonators and blasting powder on any shelf in the house, let alone in the vicinity of a radio transmitter. Come to think of it, I don't quite know where I would put the stuff!

The "article in question" to which our correspondent refers is actually a letter from an amateur, written to and published in the May, 1961, issue of the W.I.A. journal, "Amateur Radio." Having thus fully acknowledged same, I am following the suggestion to reproduce it in toto, in view of the fact that many operators of commercial mobile gear may not thus far have seen it.

As to the figures quoted, I am not in a position either to question or to verify them. If any readers are—then these columns are always open to contributions.

By Neville Williams

MOBILE STATIONS—BEWARE!

"Dear Sir,

"I would like to draw the attention of all Radio Amateurs to a most unusual hazard which I have come across recently. It concerns chiefly mobilers whose ranks are mounting daily and it was while I was operating 40 mx mobile myself recently, during my annual vacation, that this potential danger impressed itself upon me.

"It concerns the use of electric blasting caps to set off explosive charges. The hazard is found most commonly along main roads and highways where roadworks, etc., are in operation and, of course, where Amateur mobilers are very likely to be found.

"In N.S.W. it is customary for road signs to be exhibited in the vicinity of road works where blasting caps are being used. These state "BLASTING—SWITCH ALL RADIO TRANSMITTERS OFF."

"Piqued by one of these signs, I inquired of the Department of Main Roads of N.S.W. for more particulars. They referred me to an article published in 'The Explosives Engineer,' of Sept.-Oct. 1951, wherein this matter is discussed rather fully.

"I would like to quote some of the relevant passages in order to familiarise Amateurs with the problem and so avoid unpleasant possible consequences, both to persons involved and to Amateur Radio in this country.

"The wires of an electric blasting cap can act as an antenna and pick up radio energy, and if the configuration of wires is just right, and the radio transmitter is close enough, the bridge wire in the cap can be heated sufficiently by the radio frequency current produced in the wires so that the cap can be exploded.

"The current needs to be of the order of 0.25 ampere or more.

"The greatest danger arises when the two wires of the cap have a total length equal to one half wavelength with the cap in the middle. A serious danger also exists if one wire is one quarter wave length and the other is grounded close to the cap.

"It has been reported that an electric blasting cap placed in the rear compartment of a police car which had a transmitter was exploded while the transmitter was operating.

"In experiments with a 100 watt Amateur Radio it was possible to shoot electric blasting caps 20 to 30ft below the horizontal antenna."

"The article then goes on to suggest "the desirable minimum distance or separation between radio broadcasting

ansmitters and such blasting opera-ons." These include:—

1. **Input power between 0 and 30w.— —100ft.**

2. **Input power between 30 and 100w —200ft.**

"It is suggested also that **"for closer stances the transmitter should be kept rictly turned off and preferably locked."**

"On reflecting these statements, one alises that a 33ft lead to one of these ectric blasting caps is quite feasible and deed probable; it happens to form a sonant half wave on 40 mx, our com-onest mobile band, with the cap situ-ed at a current peak in the centre.

"This condition holds too with lead ngths of odd multiples of 33ft which e even more likely to occur. The cur-nt necessary to set the cap off is also ry little and, by way of comparison, it similar in magnitude to the current in small torch globe.

"So with these thoughts in mind, I ggest that Amateurs watch for any lasting signs should they be using their ansmitters, and that they at least cut eir carrier smartly until well past the otential danger zone."

ABOUT STYLI

My remarks last month, on the sub-ct of stylus wear, seem at least to have irred a few ripples in the placid sea indifference. (I should be able to ork in something about complacen-a!)

Though, as I write, only a few days ave elapsed since the article appeared print, quite a few readers have com-ented that it was time the whole ques-on was aired in some such fashion.

One of the Sydney Amateur Astrono-er group, whose work was featured in e same issue, rang to say that he had een shocked and intrigued by the rticle. That very night he had plucked e stylus from the family radiogram nd taken it to the group headquarters here a stereo microscope is available.

It took very little time to establish at the original hemispherical tip had rtually disappeared, having given place a cone-like wedge (or a wedge-like ne if you prefer it) with flats at least 02 inch long. But more was to fol-w.

The object in question was shown to succession of group members—I think ght was the number mentioned—each ith a family radiogram.

Not one of them had given any hought to stylus wear, having been old in the first place that the stylus as "permanent."

And one can hardly blame them for inking otherwise. As was pointed out, nless one deliberately stops to work out e distances involved and the pressure n the stylus in terms of pounds per uare inch, why should one expect re-tively soft, yet polished vinyl to wear jewel so rapidly?

CLUB'S ATTITUDE

Then from the Melbourne office of e World Record Club, I received an nvelope and a brochure illustrating the lub's attitude to the problem. The rochure was endorsed in red ink "This rvice is over three years old. It started Melbourne in November 1957."

The brochure points out that the aver-ge stylus traces out 15 miles of groove during 30 hours of playing time. It does this while carrying 300 times its own weight and reversing its direction of travel relative to the groove line many thousands of times per second. The weight on the stylus may approximate 40 tons per square inch. (World Record Club figures.)

In the light of the above, and based on experience, the Club suggests that the average sapphire stylus should not be be used for more than 30 playing hours, equivalent to about 70 12-inch LP sides. In addition, records should be kept scrupulously clean to avoid increasing the wear by dust abrasion in the grooves.

USEFUL LIFE

They recommend the use of diamond styli and estimate their useful life as 50 times that of a sapphire.

In case members have doubts about these figures, the club offers a stylus inspection service. Members are invited to remove their stylus and bring it to the office for inspection at a modest charge of 1/. If need be, a new stylus can be supplied, in which case the 1/ is not charged.

Average cost of a new sapphire stylus is given as 13/6. Diamonds are quoted as about £7 first grade and £4 second grade.

(I imagine that these last descriptions could promote some interesting arguments as to what are first and second grade diamonds!)

Chatting with the Sydney office of the club, they stress that it is in their own interests to keep their club members happy. And it is certainly in their interests to make sure that new records sent to club members should be heard as intended and not scoured at first playing with a worn stylus!

To all of which I can only say "Bravo" or whatever one says in such circumstances. The attitude of the World Record Club contrasts rather vividly with that of some other record distributors I have contacted, who, seemingly, couldn't care less!

TRANSISTORS AND HI-FI

By way of conclusion, I would like to acknowledge a couple of letters which arrived in response to some remarks, earlier, about possible interest in battery-operated transistor stereo amplifiers, with more fidelity than is usual with transistor devices. It was pointed out, at the time, that there was no fundamental reason why transistor amplifiers should use little transformers and little speakers, to produce little bass.

The letters in question come from R.F. and M.J.G. at widely separated addresses in New Guinea. Both stress the need for something better than the usual quarter-watt and 3-inch speaker, when one wants to listen to serious music. M.J.G. appears not to be worried too much about economy, because he speaks blithely about 4 to 10 watts of output. That may be all right for storage battery supply but not dry batteries.

However, even a couple of 1-watt stereo channels can make a lot of noise when fed into efficient, properly baffled speakers. This note will suffice to show that the subject has not been forgotten!

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Further Notes On Narrow-Band Filters

(Continued from Page 45)

notograph of Fig. 3 showing the com-eted unit will clearly illustrate this. The actual size of the unit when com-eted is 1 x 1 x 4in; it could be made aller if desired.

Fig. 4 is a graph showing the plotted ndpass of the filter. From this it n be seen that the bandwidth is 6Kc 6dB down, while the shape factor better than 3 to 1. The total inser-n loss is 25dB, perhaps a little on high side but not so much that it nnot be compensated for by a single plifier valve.

The bandwidth of 6Kc is perhaps a le wide for single sideband reception t it is ideal for a general purpose re-ver, used mainly to copy medium or ortwave AM stations. Speech or sic will be passed with some loss of hs while adjacent channel interference l be kept to a minimum.

Here then are two more bandpass ers which can easily be constructed d placed in your receiver. There is, in t, no reason why any enthusiast should ke do with inferior selectivity charac-istics in his receiver. All the materials ed are readily available and quite eap while the constructional work in-lved is by no means difficult.

An IF strip using some experimental rium titanate resonate ceramic discs at present under development in our oratory and it is hoped to present tails of this in the near future.

FIRST AUST. QSO ON 10,000 Mc.

Last month two Sydney amateurs established the first contact within Australia on 10,000Mc. These amateurs, Alan Nutt VK2DN, and Keith Jeffcoat VK2BK, are both members of the technical staff of "Radio, Television and Hobbies."

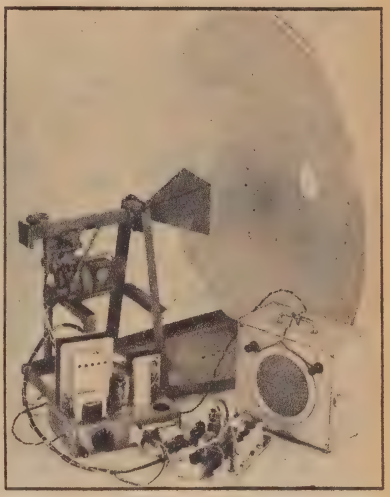
THE contact was established on Saturday, June 3rd at 3 p.m. in one direction, using 144 Mc as the return half of the link. The distance covered was approximately 5 miles and during the entire contact, which lasted one and a quarter hours, signals were R5 and S9 both ways.

The transmitter, operated by VK2DN, was situated in the R, TV and H. offices, while the receiver operated by VK2BK, was installed atop the N.R.M.A.'s new building in North Sydney.

The equipment used was built around two of the klystron units recently released by the W.I.A. disposals committee. The klystron transmitter was frequency-modulated by placing a suitable transformer in the reflector lead and applying a signal from a simple audio amplifier.

At the receiving end use was made of the existing 30 Mc. IF strip and AFC chassis, the latter suitably modified to function as a wide-band discriminator and audio amplifier.

The antennas consisted of horn fed parabolas at both ends.



It is hoped that, with further modification of the equipment, a two way contact will be established over a distance of 50 miles in the near future.

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The amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with dress plate to match deck. Output: 4 watts can be used as straight amplifier if required.

Model TR2 incorporates the ne Collaro "Studio" Deck whic features:—

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- **Three speeds, 1-7/8, 3¾ and 7½.**
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- **Light piano key controls.**
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- **TAPE MEASURE AND CALIBRATING DEVICE**

The three digit counter makes the location of any recorded passage simplest of operations.

- **TRANSCRIPTION TECHNIQUE**

A large diameter flywheel with ground and lapped steel shaft running o ball at the bottom of long bearing reduces friction and virtually elimin "wow" and flutter at less than 0.15 per cent at 7½in per second.

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Stereophan LIVING SOUND

16 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and two Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis. **£69/15/-** F.O.R.

Two pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency response of amplifier 40 to 15,000 cycles.

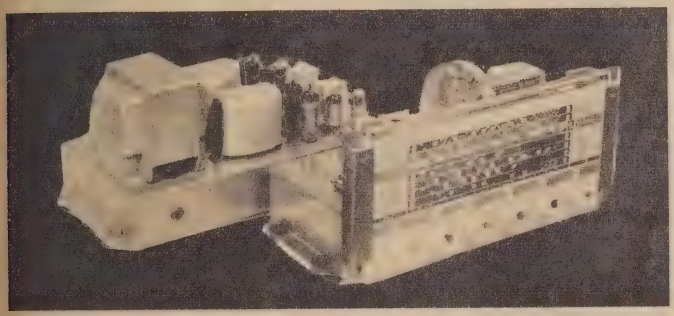
THIS UNIT CAN NOW BE SUPPLIED WITH THE NEW ROLA 12 PX SPEAKERS

10 VALVE HI-FI STEREOGRAM CHASSIS

Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£49/15/-** F.O.R.

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 2-2" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles. **£41/15/-** F.O.R.



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NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial supplied in cream with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

COMPLETE RANGE OF DUAL, COLLARO, B.S.R. AND GARRARD, STEREO PLAYING EQUIPMENT IN STOCK

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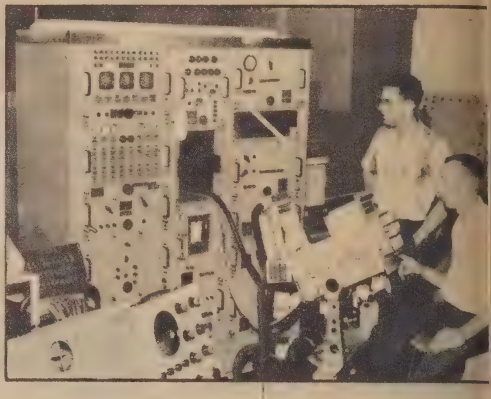
TRADE REVIEWS AND RELEASES

PRECISION INDUSTRIAL ELECTRONIC EQUIPMENT

Ronald J. T. Payne Pty. Ltd., announce that they are able to supply or obtain a wide range of imported precision electronic test and measuring equipment, including that made by the British Solartron company, and Messrs Etelco, also of the United Kingdom.



AN example of the type of equipment and a typical application is shown in the photograph, at right. This shows the Automatic Check-out Equipment, Dattico Mk. III produced by the Nortronics Division of the Northrop Corporation of U.S.A., as set up for use on the Polaris missile project.

A large part of this equipment incorporates British Solartron dynamic analysis equipment, modified by Solartron Incorporated U.S.A. for this particular requirement. Two of the items involved are shown in the extreme right hand rack, above and below a censored item, which is being checked.

Also available is a wide range of cold cathode tubes for industrial and scientific applications, produced by Etelco. These include Dekatrons, Trochotrons, Digitrons, trigger tubes, stabilisers and reference tubes, Alphabet tubes, etc. Many of these are in vibration resistant or long-life versions, making them particularly suitable for specialised applications.

Design engineers and others requiring further information on this or similar equipment are invited to contact Ronald J. T. Payne Pty. Ltd., 385 Bridge Road, Richmond, Victoria.

NEW STYLE STEREO HEADPHONES

A new style of stereo headphones, recently released by Hodges Sound Systems, should prove of particular interest to those audio enthusiasts keen to employ this method of stereo reproduction.

THESE phones differ from previous examples such as the A.K.G. in that they are virtually a pair of miniature moving coil speakers, each housed in a plastic case and fitted with plastic foam pads. For this reason they are somewhat more bulky in appearance, but nevertheless quite light in weight and comfortable to wear.

Possibly for the same reason, the acoustic output, i.e., as observed by persons other than the user, is somewhat higher, though not to the point where this would normally constitute a nuisance.

Checked on a generator, it appears that the response tapers gradually from 100 cycles down, but is well sustained up to 12 Kc., tapering thereafter. Some irregularities were noted between 4 Kc. and 8 Kc., but it is doubtful whether these are severe enough to be noticeable on normal program material.

The phones are supplied complete with a small control box containing dummy speaker loads, etc., to enable them to be connected directly in place of the speaker voice coils. The system is so balanced that signals producing a normal listening level from average loudspeakers will produce comfortable listening level in the phones. Once fitted, this control box permits either phones or loudspeaker to be selected as required by means of a two-position switch.

Tested on normal stereo program material, these phones performed well and would seem to offer a high order of performance at moderate cost. The price quoted, £10/16/ includes the control box, making the whole combination an attractive propostion.

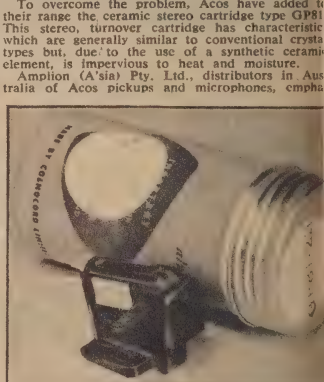
Further details, trade inquiries, etc., from Hodges Sound Systems, 126 Buckingham Street, Sydney.

NEW ACOS CERAMIC STEREO CARTRIDGE

A PROBLEM with ordinary "crystal" pickup cartridges is the relative intolerance of the rochelle salt element to extreme heat and/or humidity, as experienced in parts of Queensland and Northern Territory, or in portable record players exposed to the direct rays of the sun.

To overcome the problem, Acos have added to their range the ceramic stereo cartridge type GP81. This stereo, turnover cartridge has characteristics which are generally similar to conventional crystal types but, due to the use of a synthetic ceramic element, is impervious to heat and moisture.

Amplion (A'sia) Pty. Ltd., distributors in Australia of Acos pickups and microphones, emphasise that the ceramic cartridge is not intended to supersede their regular crystal units, which are available to a variety of specifications.



The new ceramic cartridge is contained in a moulded body and clip, which allows it to be used in ordinary pickup arms with mounting screws at about ½in centres. For full bass response, it should be used into a 2-megohm load shunted by 100pF, the latter in many cases being made up of cable and stray capacitance.

On test, both channels showed a system response rise of about 6 db. But for this, the response was fairly level between 40 cps and 12 Kc. In line with specifications, channel separation at 1 Kc was 15 db, diminishing somewhat toward to the top of the range. The difference in channel level, in the unit tested was only about half the rated maximum permissible of 3 db.

The GP81 is available with sapphire stylii for 78 and microgroove for £3/19/6 retail. With sapphire for 78 and diamond for microgroove, retail price of the cartridge is quoted as £8/7/

[Available through all trade houses. Amplion (A'sia) Pty. Ltd., 29 Major's Bay Road, Concord, N.S.W.]

AWV 6GM6 TV IF AMPLIFIER

OF particular interest to TV design engineers is this latest TV IF amplifier valve recently released by AWV. It is designed to provide an improved control characteristic while retaining the high mutual conductance necessary in this application.

The 6GM6 is a semi remote-cutoff pentode of the seven-pin miniature type, especially designed for use in gain-controlled picture-IF stages of television receivers operating at frequencies of the order of 40 megacycles.

The 6GM6 has high transconductance (13,000 micromhos) and relatively low capacitance, features which contribute to a large gain-bandwidth product. The semi remote-cutoff characteristic of the 6GM6 minimises envelope distortion and cross modulation and enables the 6GM6 to handle large signal voltages.

The 6GM6 is provided with separate base pins for grid No. 3 and the cathode. This arrangement

permits the use of an unbypassed cathode resistor to minimise changes in input conductance and input capacitance with bias, without causing oscillation which may otherwise result if grid No. 3 were internally connected to the cathode.

TECHNICAL BOOK REVIEW

LEARNING MORSE: A Guide to Wireless Operating. Thirteenth Edition. By H. F. Smith, former editor, "Wireless World." Published for Wireless World by Iliffe Books Ltd. Soft cover, 20 pages, size 7¼in by 4¼in.

This newly revised edition will be a helpful guide to all who wish to master the international morse code. The booklet gives details on some time-proven methods of learning the code, key manipulation and methods of practice.

Equipment is described, including an easily constructed transistorised practice set, complete with a schematic drawing of the layout and circuits.

The international morse code is given in full and includes the alphabet, accented letters, numerals, abbreviated numerals, punctuation and other signs in tabulated form. The revised Q code as approved at the Geneva Telecommunication Conference 1959 is included; this comes into operation during 1961. Finally, a series of practice groups and rhythmic groups completes the book.

Our copy came direct from the publishers but copies should be available on the Australian market in due course.

★ ★ ★

BASIC TRANSISTORS, by Alexander Schure, Ph.d., Ed.D. Published by John F. Rider, Inc., 116 West 14th Street, New York 11, New York. Soft cover, 152 pages, 6 by 9 inches. Contains circuits, graphs and illustrative drawings.

The New York Institute of Technology has for some time been experimenting with new methods of teaching. This book makes use of the new concepts in education which have resulted from their research and experimentation. The text is highly pictorialised and presents only one important concept per page. Question and problem pages appear throughout the volume to emphasise the major points presented.

The book opens with a discussion of atoms and semi-conductors and then analises the basic p-n junction diode. This section deals quite fully with such things as atomic structure, crystal lattice phenomena, transistor nomenclature and semiconductor basics. The manner in which the text is presented makes it extremely easy to follow and has the effect of rooting the basic facts firmly in one's mind.

Basic transistor circuits are then examined and their action completely described and analysed. Coverage includes transistor biasing, transistor characteristics, conventional and power transistors, transistor amplifiers and oscillators, and tetrode units.

This would appear to be an excellent book for anyone who wishes to study the subject in some detail and in as painless a manner as possible.

Our copy of the book was direct from the publishers and no Australian price was given. However, it should be available locally in due course. — K.W.J.

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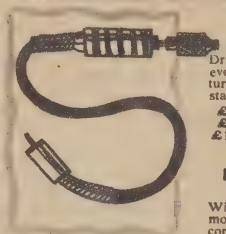

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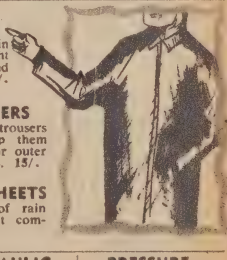

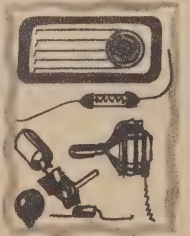

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1,200ft of twin sided tape on 7in plastic spools. 29/6.
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WIDE PROTEST ON FM SHUT-DOWN

Centre of interest in hi-fi circles during the last month, was the furore which following the announcement that the F.M. broadcasts were to be terminated. The reaction was far more positive and far more widespread than officialdom could possibly have expected.

By Neville Williams

IT so happened that I was in Melbourne, when the news was released, doing the rounds of the trade and of hi-fi centres in particular.

First reaction was one of incredulity. The transmissions had been going on for so long—over 10 years—that they had been accepted as a permanent service. To be sure, they were still officially "experimental" but one would be at a loss to suggest what mere "experiment" would need regular broadcasts over a period as long as these had been going.

On the strength of this, hi-fi dealers had felt completely justified in importing quite substantial numbers of FM tuners and in recommending them to their valued clients, along with the usual array of pickups, amplifiers and loudspeakers.

Unfortunately, inquiries in official circles confirmed that the reports were only too well founded. Dealers looked with dismay at the array of now useless tuners on their shelves and the paperwork covering many more already on the water.

Nor did they relish the ill will which clients would feel, who had recently been persuaded to invest in the same.

Back in Sydney, our office phones ran hot with calls from readers who couldn't wait to write a formal letter. But plenty of letters were certainly being written to the Australian Broadcasting Commission, who quite wrongly received the blame for the decision. One official, who must needs remain nameless, told Technical Editor Phil Watson that he had a stack of letters on his desk "which a kangaroo could not jump over."

IN PARLIAMENT

Plenty of letters, too, reached Canberra, with the result that questions were soon being asked in Parliament. From the replies thereto, it was obvious enough that the matter was up for further consideration—though with what result I can only guess, at the time I write these notes.

But one thing has been demonstrated quite forcibly: A very large number of people have been enjoying the FM broadcasts, despite their unpublicised and "experimental" basis. A far greater number will make use of them if and when they are put on to an official program basis, supplying the kind of music that hi-fi enthusiasts want.

On another subject, I recently "sighted" a basic reverberation unit of the type being handled in Australia by the Rola organisation. I say "sighted" because it is now in the hands of one of our staff members currently working on an electronic organ. To such a zealot, electronic organs are far, far, more important than mere amplifier systems.

The unit in question follows the Hammond pattern of a couple of springs connecting transducers at each end. A signal, fed into one end, applies an oscillatory twisting action to the springs. The movement travels along the springs to transducers at the other end which convert the movement back to an electric signal, suitable for application to a second amplifier channel.

The signal is subject to such complex reflection and delay, that the sound has all the quality of having been subject to reverberation effects in a large building. In this respect the unit is most effective.

It is noteworthy also that the twisting action required to generate a signal obviates most of the microphonic effects which one would expect of such a unit. Ordinary vibration does not produce significant drumming from the reverberated channel.

DISSIMILAR SPRINGS

The use of two dissimilar springs operating in parallel is intended to produce a substantially level response through the mechanical linkage system. At a later date we hope to have more to say about this unit.

Meanwhile, the thinking about commercial radiograms and reverberation is gradually becoming clearer. While there will doubtless be exceptions, the dominant opinion at present seems to be that nothing is to be gained by trying to add reverberation to a genuine stereo presentation.

Rather, it should — or rather may — be added to one channel of a stereo system when it is reproducing mono material, as from a mono disc, a mono tape deck or a radio program. Even then, the use of reverberation is subject to the type of material so that, as often as not, "straight" reproduction may be preferred.

However, rather than expand further on the discussion, personally, I can more easily quote from publicity material recently received from the Philips organisation and relating to a stereo radiogram with reverb. recently released by their European principals.

What follows is reprinted from the said data.

In Holland, Philips recently announced the appearance of a radio and stereo-gramophone combination incorporating a device for artificial reverberation. This further enhances the concert-hall illusion within the living-room. The following article briefly explains the significance of reverberation and describes the system applied in this new equipment.

When sound is produced in a large hall, the listener hears the sound directly, but also via many "reflections" (or echoes) from walls, ceiling, etc. The total effect of all these reflections is called reverberation.

REVERBERATION TIME

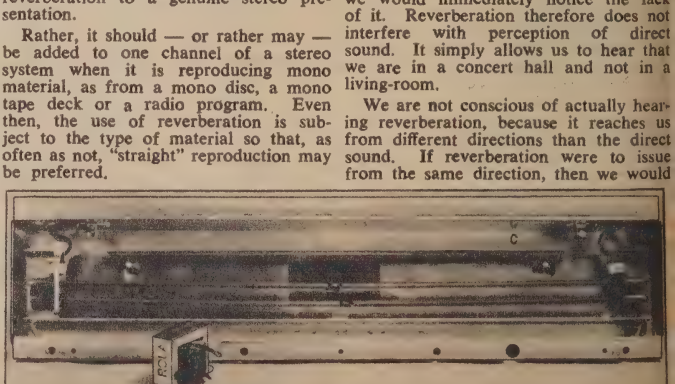
The time elapsing between the moment when the direct sound disappears and that when its reverberation has completely died out is called the reverberation time. As a rule, sound becomes practically inaudible if it has dropped 60 dB below its initial volume.

Reverberation depends upon the size and the acoustic damping of the hall, meaning that there is less reverberation as the hall is smaller and the furnishings and upholstery have a stronger damping effect. The reverberation time of a concert hall is between two and 2½ seconds, while that of the average living-room is about half a second.

If a concert piece written to be performed in the concert hall is to be done full justice via a gramophone recording, then it should be reproduced with all the reverberation that occurs in the concert hall.

Listening to music in a concert hall, we are unaware of hearing reverberation, but if it were suddenly removed, we would immediately notice the lack of it. Reverberation therefore does not interfere with perception of direct sound. It simply allows us to hear that we are in a concert hall and not in a living-room.

We are not conscious of actually hearing reverberation, because it reaches us from different directions than the direct sound. If reverberation were to issue from the same direction, then we would



Inside view of the reverberation unit currently being handled by the Rola Company. Note the twin springs, terminating at each end in rotary type transducers.

be aware of it and it would have a noticeably interfering effect.

This is why monaural gramophone recordings have to be made without reverberation.

In monophonic reproduction, all sound issues from the same source, so that reverberation would spoil our perception of the direct sound. As a consequence, reverberation is lacking altogether when we are listening to monophonic records.

Any addition of reverberation, provided it reaches us from a different direction than the direct sound, will result in a more true-to-life reproduction.

In stereo recordings, not only the sound, but also the direction from where it seems to issue has been recorded. This makes it possible to record reverberation as well, because in reproduction it will appear to issue from the original directions.

NOT FOR STEREO

This is the reason why in stereo playback equipment the artificial addition of reverberation is not as essential as it is to monophonic equipment.

There are several methods for obtaining artificial reverberation.

The simplest of these uses the reverbration of another, hollow-sounding room, for example, a large, empty cellar.

The direct sound is reproduced in the listening room as well as in the cellar, the latter being fitted with an additional microphone. This microphone picks up the reverberation in the cellar and is connected, via an amplifier, to a second loudspeaker in the listening room, thus adding the desired measure of reverberation.

This method is expensive and takes up a lot of space. It is therefore only used for professional purposes.

In another method, the echo-cellar is replaced by a long length of tubing, with a loudspeaker at one end and a microphone at the other end. The sound waves have to cover a certain distance through the tube, which requires some time, while there are also reflections. The total effect is a form of reverberation.

One great drawback of this method is the limited frequency range of the reverberation thus produced. The high notes are absorbed by the tube, while transmission of the low notes is considerably impeded owing to the low ratio of the tube diameter to wave-length.

A third method employs an additional playback head on a tape recorder provided with an endless tape. The additional playback head produces a signal a fraction of a second after it has been recorded by the recording head.

TOO EXPENSIVE

A feedback arrangement can thus produce an excellent reverberation, but this method is prohibitively expensive. In frequent use, wear of the tape makes regular replacement necessary, which is a fairly difficult operation for the layman.

We have not yet mentioned the method in which a steel spring is used as the delaying element. This method is applied in a recent Philips radiogram under the trade-name "Reverbeo." The additional reverberation unit consists of a preamplifier and the reverberator.

With this system the radiogram can produce excellent reverberation by a fairly inexpensive arrangement using one stereo channel for reproducing the direct signal and the other one for the delayed signal.

In the reverberation unit the signal travels as follows: Via the preamplifier it is applied to the reverberator. Here the electric oscillation is converted into a mechanical vibration by means of an electrodynamic system.

Through a steel spring attached to the system the vibration is propagated as a wave and reaches a second electrodynamic system at the other end. This converts the mechanical vibrations again into electric oscillations, the latter, after being amplified, reaching the input of the second channel.

The sound thus produced is delayed by a few hundredths of a second relative to the direct sound. In addition to this, reflections are produced in the spring. The mechanical waves are repeatedly reflected at the ends of the spring and thus produce repetitive electric oscillations in the playback system.

The vibrations in the spring take about two seconds before being reduced by 60dB, which corresponds to an acoustic reverberation time of two seconds.

In order to obtain the greatest variety in reflections, the unit is fitted with two springs, while both springs are interrupted in the centre. These central joints give rise to additional reflections.

The radiogram combination described above is fitted with three push-buttons above the scale, marked "reverberation," "stereo" and "mono." This provides the following possibilities:

"Mono:" With this push-button depressed, all signals are reproduced monophonically via two separate channels.

"Stereo:" With this button depressed, stereo signals are reproduced stereophonically via two separate channels.

"Reverberation:" With this button depressed, all signals are directly reproduced monophonically via one channel and their reverberations via the other channel. Reverberation can be adjusted as desired by a balance control.

PLAYED AS MONO

When stereo records are reproduced with the "reverberation" button depressed, the fact that the two stereo signals are applied to a single channel will result in monaural sound. Just as with monophonic records, reverberation is produced via the second channel.

It has already been pointed out, however, that the addition of reverberation to stereo is by no means equally essential, because the recording procedure itself permits the addition of reverberation to a far greater extent.

A Review of Sacred Records

WHEATON COLLEGE, Centennial Album Number 2. Produced by Paul Mickelson, Mono. Word W-3101-LP (Gospel Film Ministry).

Issued to commemorate the centenary of Wheaton College, this album would have special significance to anyone having a personal link with the college, in particular the short tracks devoted to "Alma Mata" and the "Tower Bells."

However, the disc has a much wider potential appeal than this. With a personal message by Dr Billy Graham and singing conducted by Cliff Barrows, much of the music and atmosphere is that of the Billy Graham Crusade, which was apparently coupled with the centenary. Whether sung by the Wheaton Crusade Choir or by one or other of the college groups, the old gospel hymns are presented simply, yet with conviction.

Included are "Glorious Things," "O God Our Help," "I Am Trusting," "All That Thrills," "And Can I Be," "To God Be The Glory," etc.

The recording quality is excellent, with enough big organ bass notes to satisfy the hi-fi enthusiast.

The disc comes, by the way, in a stout double-fold imported album.

★ ★ ★

ANCHORED, Haven of Rest Quartet; Produced by Paul Mickelson. Stereo, Word W-3106-LP (Gospel Film Ministry).

Featured over the years in the "Haven of Rest" radio program, the quartet sings without gimmicks and avoiding abrupt changes of tempo or mood. Theirs is a strictly conventional presentation, backed by organ only and with the accent on harmony. And excellent harmony it is.

The program includes "Haven Of Rest," "Farther Along," "Have Thine Own Way," "Grace, Greater Than Sin," "Rose Of Sharon," "Wonderful," "Just A Little Talk," "He Hideth My Soul," "When I Survey," "My Sins Are Gone," "When Jesus Beckons," "Known Only To Him" and "Hallelujah For The Cross."

The recording quality and stereo balance is excellent throughout, except for a vague trace of distortion on the end of side two.

A pleasant and conservative presentation of favourite hymns.

★ ★ ★

THE LUTHERAN HOUR. Choir conducted by Dr William B. Heyne. Recorded in the Holy Cross Lutheran Church, St. Louis, Missouri. Mono. RCA L101013.

The "Lutheran Hour" religious broadcast is radiated by over 1,200 stations in more than 54 languages. Some of the stirring hymns featured from time to time in the broadcast are heard on this disc.

Under the baton of Dr William B. Heyne, the hymns are presented by the St. Louis A. Capella choir, the 83-voice male chorus of the Concordia Seminary, brass choir drawn from the St. Louis Symphony Orchestra and pipe organ.

With the accent sometimes on harmony, at others on massive sound, the presentation is consistently of a high standard.

Of high standard, too, is the recording itself—a quiet surface and free from distortion, even on the loudest passages.

The titles, abbreviated, are: "A Mighty Fortress," "O Gracious Father," "Now Thank We All," "Gates Of Beauty," "Rose E're Blooming," "Beautiful Saviour," "From Heaven Above," "How Lovely Shines The Morning Star," "Oh Head All Scarred," "When I Survey," "Wake, Awake," "O Bless The Lord" and "All Hail The Power."

(Continued on Page 73)

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The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in most popular values.
List price £5/10/ per 100.
The potentiometers are all current types and include switch pots and dual concentric. List price £6 per doz.

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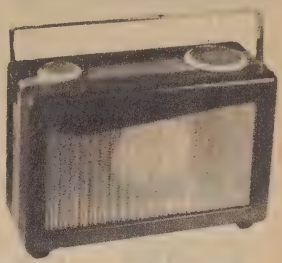

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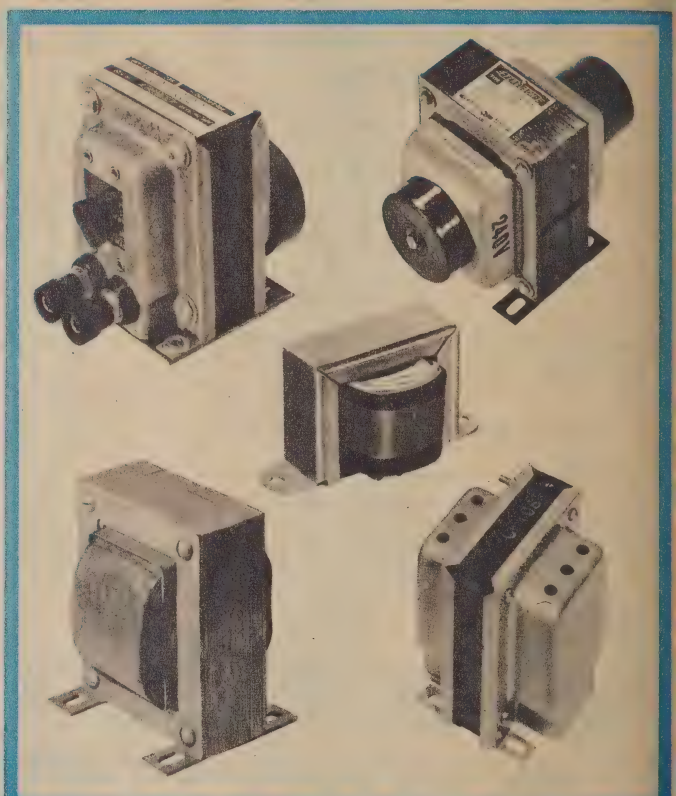

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THE HOLY LAND, George Beverley Shea with orchestra and choir conducted by Norman Leyden. Produced by Brad McCuen. Mono, RCA L101038.

George Beverley Shea, soloist of the Billy Graham team, adds to his already imposing list of recordings with this musical tour of the Holy Land.

The titles, "Zions Stands With Hills Surrounded," "Beautiful Garden of Eden," "Go Down, Moses," "Jordan's Stormy Banks," "Joshua Fit the Battle," "We're Marching to Zion," "The Lord Is My Shepherd," "O Come Emanuel," "Memories of Gallilee," "Break Thou the Bread," "Calvary" and "Christ the Lord is Risen."

Not all the titles will be as familiar as the gospel songs for which Bev. Shea is so well known but the disc makes good listening none the less. Of special note is the presentation of "Joshua Fit the Battle of Jericho."

Technically, the recording is first rate, with the kind of bass content that is felt as much as heard, and not a click or a pop to mar the surface.

★ ★ ★

MASSED CHORUS OF THE SCOTTISH FESTIVALS OF MALE VOICE PRAISE, conducted by James McRoberts. Mono, Parlophone GEPO 8810.

The cover notes of this seven inch disc explain that "The Festival of Male Voice Praise" is an organisation which recruits and trains choirs all over Scotland, bringing groups together on occasions for festivals, concerts and broadcasts.

They present here "Glorious Freedom," "Happy Jubilee," "Burdens Are Lifted At Calvary" and "Christ Is Coming," all in simple, straightforward style.

But I can't recommend the disc to anyone who is quality conscious. Neither the original microphone placement nor the frequency response of the finished disc is up to modern fidelity standards, though it should sound pleasant enough on simpler record players.

In Varied Mood

ADVENTURES WITH ALBERT, Stanley Holloway. Mono, 45 r.p.m. Columbia, SEGO 8034.

In November, 1934, Stanley Holloway went on record with the tale of one Albert Ramsbottom who (1) got himself "eat" by a lion at Blackpool; but Albert returned (2) to experience other adventures, including (3) one with the Tower 'eadsman and another (4) with a presentation sovereign.

Need I add that I was a keen Albert fan in those days. In fact, Calvin Walters and I even got around to writing some more Albert adventures, which were published in this magazine.

Well, here's an EP disc with the four monologues listed above, re-dubbed so well from the original 78s that you'd never pick them as anything but a taped original.

A "must" for fans of the inimitable Stanley Holloway.

★ ★ ★

THE BEST OF THE GOON SHOWS, Peter Sellers, Harry Secombe and Spike Milligan. Mono, Parlophone PMCO 1129.

I understand that, to get full enjoyment from the Goon Shows, you have to be educated to them. It is best also, to arrange to have heard them in context and against the background of some news item or situation which they are intended to lampoon!

Be this as it may, one would have to be pretty sour not to laugh loud and long at the antics of the Goons in their "Tale of Men's Shirts" (Side one). It concerns a dastardly plot to undermine Britain's war effort by having officers' shirt tails explode each time they are sat upon.

By comparison, I found "The Scarlet Capsule" on side two rather tame, though Goon Show addicts will still find all the noises in it calculated to reduce them to helpless hysteria.

Recording quality? Ooh, ar, ah, umm, owh, er, I'd say it was foine!

★ ★ ★

THE KING AND I, Richard Rodgers and Oscar Hammerstein II. Orchestra conducted by Johnny Douglas, produced by Cyril Ornadel. Stereo, World Light Record Club, LM 7013.

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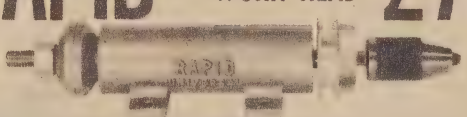

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This offer is for goods purchased after the 1st July, 1961, for a limited period only.

Model M7D Custom.

The M7D Stereo Custom Dynetic is designed for the purchaser who wants a quality stereo cartridge at a moderate price. It has a frequency response ranging from 20 to 15,000 c.p.s., and a tracking force of from 4 to 7 grams. It has 4 terminals but can be adapted to a 3-terminal arm. It's priced at £22/16/-

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Model M3-N21D. Professional.

This model features the famous N21D tubular stylus, designed for use where the tracking force is not greater than 2½ grams. It has a frequency response of from 20 to 20,000 c.p.s. and has 4 terminals but is adaptable to 3-terminal arms. The price is £44 17 6.

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with notable clarity from the area between speakers while the orchestra, equally well defined, spreads out to either side.

Reproduction is basically clean and surface noise nil but the critical listener may notice recurrent emphasis on frequencies at about A on the piano scale. This is due, I think, to some accident of acoustics on the recording stage, or it could be a microphone feedback effect.

Perhaps this had something to do with the note which explains that on the stereo version "The Song of the King" had to be omitted "due to technical difficulties."

But, despite this reservation and a few ragged spots in the singing, the fact remains that this is a pleasant and tuneful memento of a musical which has been a hit on both stage and screen.

★ ★ ★

TAKE ME ALONG, with Jackie Gleason, Walter Pidgeon, Eileen Herlie, Robert Morse and Una Merkel. Stereo, RCA SL 101020.

Based on the play, "Ah Wilderness," "Take Me Along" is an original cast recording—and it sounds like it. The cast sings with an ease and an assurance which indicates complete familiarity with the plot, the lyrics and the music. Orchestral support is likewise excellent.

"Take Me Along" is the story of a small-town newspaper publisher (Walter Pidgeon) who enjoys a certain acclaim from the townspeople but who is equally in need of assurance that he deserves it.

Unfortunately, his would-be simple affairs are complicated by various indiscretions, committed by family and friends, and some all-too-familiar situations are described in verse before everyone settles down to live happily ever after.

Easy to listen to, tuneful and very well recorded!

★ ★ ★

BLACK BEAUTY AND OTHER GREAT STORIES, Marian Ray, with cast; music by Eddie Manson. Mono, RCA Camden CAM-70.

Here's excellent value if you're looking for a present for the children. Expertly narrated, with simple dramatisation and effective musical background you get:

"Black Beauty" — the horse which saved its master and mistress.

"The Selfish Giant" — who learnt to be unselfish.

"The Emperor and the Nightingale" —a bird who wanted only to sing and do good deeds and—

"Schnappsie and the Magic Button"—a puppy with a fairy for a friend.

You'll enjoy the recording, along with the kids—all the more so because the sound quality is beyond criticism!

★ ★ ★

FAVOURITE MUSIC OF HAWAII, James Michener. Orchestra and chorus from "The Oratorio Society of Honolulu" and "The Marie Tarangi Trio," directed by Jack De Bello. Mono, RCA L101044.

Having read through the foregoing title information, it comes as no great surprise to find the "Music of Hawaii," offered here, a step removed from the usual dance and club atmosphere toward something that, to me anyway, sounds more authentically Polynesian.

However, as Michener points out in his notes, while much of the music is genuinely Hawaiian, some belongs more rightly to Tahiti, while other numbers have been written by outsiders in Hawaiian style.

The presentation reminded me strongly, in places, of the sound one hears from native groups in South Sea film travelogues. In short, familiar South Sea music with an acceptable difference.

The recording itself deserves full marks. Clean and well balanced, it is music out of complete silence.

★ ★ ★

THE VAGABOND KING. Rudolf Friml, conducted by Jan Cerrenka, an FCM Production. Produced by Cyril Ornadel. Stereo, World Light Record Club, LM 7016.

The Light Record Club offers this recording of songs from Friml's popular "Vagabond King" with Edwin Steffe in the title role of Villow and Lissa Gray as Catherine de Vaucelles. Support is provided by the Peter Knight Singers and Orchestra.

If not an exhilarating performance, it is certainly workmanlike and well worth the modest purchase price for anyone with a place in their collection for "The Vagabond."

Technically, the disc is of good average quality, cleanly recorded, with only the barest trace of surface noise.

★ ★ ★

LIVING VOICES SING IRISH SONGS. Mono, RCA Camden CAM-71.

Made for nostalgia is this collection of traditional Irish songs, every one a favourite in its own right. Look at the list:

"A Little Bit Of Heaven," "Rose Of Tralee," "MacNamara's Band," "Mother Machree," "Danny Boy," "Galway Bay," "My Wild Irish Rose," "It's The Same Old Shillelagh," "Too-Ra-Loo-Ra-Loo-Ral," and "When Irish Eyes Are Smiling."

With enough bass to ensure rhythm and enough plucked strings to lend variety and atmosphere, the singing is superbly spontaneous and natural.

The recording, too, is mono at its best, with presence, definition and an almost "stereo" quality when played through a two-channel system. In short, top-value.

★ ★ ★

THAT'S AMORE, The Gaylords. Stereo Mercury, SR 60102.

As Italian as the Italian section of Detroit, the Gaylords, male duettists, present a program of hybrid Italian-American songs.

Using for preference the American—or should we say English titles—you get "Goodbye To Rome," "Domani," "For The First Time," "Don't Forget," "Eh Compari," "Tell Me You're Mine," "Volare," "Return To Me," "That's Love," "Tell Me That You Love Me," "The Butcher Boy" and "Dormi Dormi."

Backed by an efficient percussion-cum-string orchestra the Gaylords provide pleasant, relaxing melody, sometimes sentimental, sometimes gay.

The recording quality is good, with the stereo emphasis on separation. And the channels are really separate in the electrical sense!

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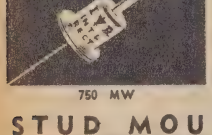

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WF 67/

IN REVIEW—By JULIAN RUSSELL

TOSCA — "Fine Performance Indeed"

Puccini — Tosca. Complete opera. Renata Tebaldi (Tosca); Mario del Monaco (Cavaradossi); George London (Scarpia); Silvio Maionica (Angelotti); Fernando Corena (Sacristan); Piero del Palma (Spoletta); Ernesto Palmerini (Shepherd Boy). Opera and Chorus of the Accademia di Santa Cecilia, Rome, conducted by Francesco Molinari-Pradelli. Decca Stereo SXLA2180/1.

Columbia's Tosca, issued back in 1953, was one of the first complete operas to have the recorded presence to which we have now grown accustomed, and sometimes, it must be admitted, a little, blase. The new Decca has still more presence allied to greater depth of sound, increased clarity of detail, and a fine stereophonic spread which enables the listener to follow the characters' movements without, however, the exaggerated two-channel juggling that sets heads moving from side to side like spectators' at a tennis match.

I'll get rid of its faults, most of them minor ones, first. The first turn over occurs at a most irritating spot — immediately before the cannon announces the escape of Angelotti—and cuts through the action in a way seldom experienced since the days of four-minute 78s. The English translation is horridly colloquial.

Mario del Monaco, mercifully discouraged from hogging the mike, still sounds very coarse-grained in his opening aria, "Recondita Armonia," but comes in with fine authority in "Vittoria" in the second act. George London is a sinister Scarpia but never suggests that character's aristocratic background. And finally, one of the opera's most beautiful themes, the one that accompanies the execution, is allowed to go for very little.

But having got rid of these I can go on to say that the performance is very fine indeed. Molinari-Pradelli's orchestra is always gorgeously rich in texture and supremely well disciplined. The Scarpia theme, that magnificent chordal progression which is heard just before the curtain rises, strikes one like a club.

The Te Deum, which brings the act to an end, swells overwhelmingly in volume and tonal richness as more and more forces enter to add their quota to the superb sound. It seems to expand in all directions. And the beautifully atmospheric prelude to Act 3 is delivered as poetically as I've ever heard it. It is good, too, to hear what sounds like a boy's voice, and not a mezzo-soprano's, in the shepherd's song that interrupts it.

And now to the title role. Tebaldi is an essentially pleasing Tosca, always vocally secure, firmly in character in a broad way, but eschewing some of the touching details that other sopranos often add to their interpretations. By the way, those who know the score well will be surprised to hear her drop the famous parlando at the end of the second act in favour of a sung phrase.

But even the most captious critic should find much pleasure in her really feminine heroine, a pampered operatic star, dignified yet temperamental, tender yet fiercely jealous. The balance throughout is admirable and the conductor maintains effective discipline without tyrannical subjugation of the soloists.

But watch your setting of the volume control. Comfortable listening to the early parts of Act 1 will bring in the superb crescendo of its closing bars at almost intolerable volume. I can offer no suggestion but an adjustment during the act.

★ ★ ★

Dvorak—Symphony No. 5 in E Minor, Op. 95 (from the New World). Berlin Philharmonic Orchestra conducted by Ferenc Fricsay. DGG Stereo SLPM138127.

Fricsay starts the symphony quite solemnly and very slowly indeed, almost misterioso. And this mood persists whenever the theme returns. It seems to me quite alien to Dvorak's essentially sprightly—and vividly dramatic—writing and is much more Germanic than Czech. This treatment has the effect of making the faster passages sound as if a contrast is being forced rather than allowed to emerge naturally from the context.

Even the majestic brass, at the opening of the popular Largo (dawn over an American forest, some say it is supposed to represent), which comes out of the speakers in a burst of superbly round tone, is taken at a surprisingly slow pace.

The engineering is not DGG's best. Detail is not as sharply defined as usual and the strings and woodwind are sometimes out of balance—the former too remote in spots and the latter revealing the deplorable modern tendency of too-close placing to the mike or monitoring them up in prominent passages.

To sum up—you'll do better.

★ ★ ★

Ponchielli—La Giocondo. Complete opera. Maria Callas (La Giaconda); Fiorenzo Cossotto (Laura Adorno); Ivo Vinco (Alvise Badoero); Irene Companeez (La Cieca); Pier Miranda Ferraro (Enzo Grimaldo); Piero Cappiccilli (Barnaba); Leonardo Monreale (Zuane); Ronaldo Giaiotti (Barnabotto), Orchestra and Chorus of La Scala Opera Milan, conducted by Antonio Voto. Columbia Stereo. SAX2359/60/61.

I can think of no one better able to create new interest in this old war-horse of an opera than Maria Callas. All her faults are again in evidence—shrillness in the top register, a pulse that sometimes throbs like an organ tremulant and a vocal arrogance that may be effective in an opera house but tends to overwhelm in one's sitting-room.

Yet she brings this preposterously artificial role to life in a manner which nowadays must be considered peerless, though what La Scala and Covent Garden audiences would have thought in the heyday of bel canto is another matter. She dominates the performance to such an extent that the sterling quality of much of her support is likely to be overlooked.

Special praise is due to Fiorenza Cossotto and Ivo Vinco for performances that match Callas' in insight and, let it be whispered, sometimes outmatch her in refinement. Piero Cappuccilli lacks the subtlety of characterisation that distinguishes the work of the three I have just named. His Barnaba, though pleasant, is never saturnine enough for that chuckling villain.

And Pier Miranda Ferraro, though eminently euphonius for much of the time, occasionally spoils everything by resorting to a series of ungentlemanly shouts.

The sound is consistently good, even to the extent of revealing some embarrassing vocal moments. But orchestrally, and in terms of balance and ensemble, the set leaves little to be desired.

★ ★ ★

Brahms—Piano Concerto No. 2 in B Flat Major, Op. 83. Julius Katchen and the London Symphony Orchestra conducted by Janos Ferencsik. Decca Stereo SXL2236. Mono LXT5591.

The balance between soloist and orchestra is excellent in the stereo but slightly favours the soloist in the mono. In both the piano's tone is a little boxy and the orchestra lacks presence by the best of modern standards. Surprisingly I found the general sound—of both piano and orchestra—rather better in the mono than in the stereo, though the mono, of course, lacks the stereo's spread.

Despite the spectacular technique we know Katchen to possess, this concerto seems to require rather more of his attention than usual. Occasionally a sense of strain can be detected quite foreign to this brilliant young man's other work. He seems to pick his way through even less difficult passages with unusual care. The result is an unaccustomed lack of authority.

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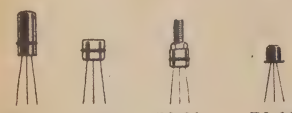

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But this is still a good performance—knowing Katchen's work as I do I should be shocked at anything less—with many poetic moments of great beauty. But it's not in any aspect comparable to Rubinstein's recently issued by RCA. Ferenscik's accompaniment is often pedestrian in temper and tempo.

★ ★ ★

The Instruments of the Orchestra. Arranged, presented and accompanied by Sir Malcolm Sargent. Decca Stereo SXLA2199.

This is an instructive disc for beginners containing more detailed information about the various instruments than the famous Britten "Young Person's Guide to the Orchestra." Sargent introduces the instruments one by one in solos designed to show more than one side of their characters. They are accompanied by Sargent himself playing piano arrangements of the accompanying parts of the score.

The unhackneyed choice of examples keeps tedium at bay for the most experienced listeners. He even includes an excerpt from Balfour Gardiner's "Shepherd Fennel's Dance," a piece I have not heard since I was a boy. The double-bass, for instance, is represented by Saint-Saens' "Elephants," with its witty quotation from Berlioz' "Dance of the Sylphs," and, for contrast, the long solo that accompanies Otello's entrance in the murder scent of Verdi's opera.

No orchestral exotica are included though the E Flat clarinet makes a welcome appearance. And no mention is made of mutes and their use in modifying the instruments' tone. All the playing is competent and much of its goes beyond that modest standard. The engineering has captured quite beautiful close-up clarity without the intrusion of extraneous sounds.

★ ★ ★

Beethoven—Symphony No. 5 in C Minor, Op. 67. Vienna Philharmonic Orchestra conducted by Georg Solti. Decca Stereo SXL2124. Mono LXT5510.

This is a splendid performance which I should recommend without hesitation but for the fact that a Klemperer reading will be on sale, too, by the time this is in print, and it is my guess that a comparison of the two will be inevitable. But the Klemperer will have to be very good indeed to challenge Solti's fine, nervous, masculine interpretation.

Defiance in the first movement is commonplace, but Solti invests his with a dignity that keeps it well on the safe side of bombast. One of the only points I feel calls for criticism is Solti's slightly over-emphatic brass in the Andante con Moto, though the rest of the movement is exemplary.

The famous Scherzo mutters its threats mysteriously before they are wiped from the memory by the second subject's superbly judged weight. The following passages in the low strings have been recorded with refreshing transparency of texture in both the mono and stereo.

A second point I feel calls for mention is the bridge passage which leads from the Scherzo to the Finale. Solti takes this slowly enough to destroy the tension that should not be relieved until the Finale itself blazes forth its message of victory.

The mono is good, but the stereo spreads a grand wall of sound along one side of a room. Though I consider this among the very best performances of the symphony available at present I still advise caution until you hear the Klemperer.

★ ★ ★

Mozart—Piano Concertos Nos. 23 in A Major (K488) and No. 24 in C Minor (K491). Wilhelm Kempff and the Bamberg Symphony Orchestra conducted by Ferdinand Leitner. DGG Stereo SLPM138645.

I can recommend this disc as a joy from the first note to the last. The only one using the same coupling is Solomon's, which has been my favourite since it was issued. But that is not available in stereo, and despite its excellence my preference now goes unhesitatingly to the new DGG.

Kempff's technique is impeccably fluent and his inflections always strictly within the limits of stylistic perfection. His tone is clean-edged yet always deliciously transparent. And the orchestra reflects a mirror image of everything he does.

His approach to the two works differs, as it should. He confines the A Major to chamber music proportions but broadens his style in the C Minor to meet its larger symphonic requirements. Some listeners who have kept their old 78s might find it interesting to compare Kempff's reading here with the one Fischer made in the last 1930s, which was outstanding for the period.

There is, of course, much difference in the engineering. But the interpretations differ, too, in a manner Mozart students will find fascinating.

The stereo spread in the new version is carefully adjusted to the needs of a small orchestra. Separation, though not pointed, is always adequate, and except for an occasional tiny surface prickle the engineering leaves not a thing to be desired.

★ ★ ★

Mozart—Clarinet Concerto in A Major (K622). Gervase Peyer and the London Symphony Orchestra conducted by Peter Maag.

Horn Concertos in D Major (K412) and E Flat Major (K447). Barry Tuckwell and the London Symphony Orchestra conducted by Peter Maag. Decca Stereo SXLA2328. Mono LXTA5593.

This should prove an attractive investment to those whose interest in Mozart is not confined to the symphonies and piano concertos, especially if they should be without Dennis Brain's disc of the four horn concertos, regarded by many as peerless.

But before making a decision I suggest that they try to listen if possible to both the stereo and mono versions of the present issue. I say this because the chamber orchestra used here does not gain much spread on the two-channel disc and some listeners might even prefer the tendency to compactness in the mono, which, despite its slight compression of the orchestral texture, loses nothing in clarity of detail and transparency.

Barry Tuckwell's playing of the horn concertos is always in exquisite taste and he surmounts all their technical problems without difficulty. He has, too, an advantage over the late Dennis Brain in the matter of slightly more up-to-date engineering.

The clarinet concerto I can recommend without qualification. Peyer's technique is faultless, his tone beguiling,

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especially in the lowest register which has a beautiful reedy tang, and his phrasing, fastidious without ever becoming precious. I can recall no more alluring performance available at present, certainly not on stereo.

Peter Maag's accompaniments are impeccable examples of that difficult art and the balance between the soloists and orchestra in all the works scrupulously in balance.

★ ★ ★

☆ **Sibelius—Violin Concerto in D Minor, Op. 47. David Oistrakh and the Philadelphia Orchestra, conducted by Eugene Ormandy. The Swan of Tuonela, Op. 22. Philadelphia/Ormandy. Coronet Stereo KLCS2740.**

This is a very attractive performance indeed, significantly different from an earlier one Oistrakh made with Ehrling and the Stockholm Festival, which was a 10-inch. The new 12-inch has The Swan of Tuonelo as a fill on the second side.

Oistrakh's first recording was harder-grained than his new one, which he delivers with much warmer tone and more flexible phrasing. He has, too, behind him the magnificent tonal tapestry of the Philadelphia under Ormandy as support.

The engineer has placed Oistrakh nearer the mike, close enough to make apparent some tiny coarsenesses of tone which would pass unnoticed in a concert hall. I do not mean by this that Oistrakh's tone is becoming coarser than it was, but that any violinist's tone would reveal traces of bow-scrape when amplified to this extent. And I must add that Oistrakh's "coarseness" is almost too trivial to mention and will offend none but the most carping of critics.

He is however, certainly close enough to dominate at moments when he might have been retired in favour of important orchestral passages. The sound is otherwise good, though I feel that a trifle more spread might have let more light filter through the orchestra's rich tone.

All the above remarks should be taken as unimportant complaints about an otherwise first-rate job. And the engineering in The Swan is superb, perhaps because there was no solo artist of Oistrakh's calibre to be considered in the studio. The solo cor anglais, who plays such a prominent role in this tone poem, is always in perfect balance, and the sound is spread to optimum advantage between the speakers.

★ ★ ★

Mozart — Four Flute Quartets. Members of the Fine Arts Quartet. Leonard Sorkin (violin); Irving Ilmer (viola) and George Sopkin (cello) with Samuel Baron (flute). Concert-Disc Stereo CS-215/29.

This is a stereo version of a mono issued late last year which had much to recommend it. The concertos themselves vary very much in interest but all receive gracefully sensitive performances here. The flute is sometimes recorded a thought too close for perfect balance, but after all it is his night, so to speak. And except from some trifling off-the-target intonation from the viola in Quartet No. 2, the Fine Arts combination co-operates to perfection.

The balance favouring the flute is by no means consistent. A good deal of the time he settles beautifully into the surrounding fabric.

Shostakovitch — Symphony No. 10 in E Minor, Op. 93. Philharmonia Orchestra conducted by Efram Kurtz. Record Society Mono 26-6026.

If you didn't buy the souvenir disc by Ancerl and the Czech Philharmonic which DGG issued at the time of that orchestra's Australian tour I can recommend this budget-priced Record Society 12-inch. If, however, you already have the former it would not be worth while making a change, since both are in mono and the margin of difference is slight.

Personally I prefer Kurtz's more propulsive direction and engineering which puts a sharper edge on the composer's brilliant score. If, however, you wish to make a short comparison I suggest you play the Scherzo of both versions and decide for yourself. Perhaps DGG's slightly more plummy engineering may appeal to you.

★ ★ ★

Tchaikowsky — Symphony No. 4 in F Major. Berlin Philharmonic Orchestra, Conducted by Herbert von Karajan. Columbia, mono 33CX1704; stereo SAX2357.

There is a spot of pre-echo before the brass announces the "motto" theme at the opening of the symphony with brilliant tone and attack. But from then on the first movement will worry those used to hearing the first subject receive normal accenting that gives it a waltz-like quality. For Karajan seems to have aimed at a legato style that traces a sinuous line without accents and in doing so changes the whole character of the music.

But even the most disapproving listener will find entrancing moments. Splendidly rich-toned climaxes in the working-out sections of the first movement are irresistibly thrilling however much you may disagree with Karajan's treatment of the movement as a whole.

And the remaining movements are treated more orthodoxly. You will find some exquisite playing of woodwind solos in the slow movement and deliciously pointed rhythms, with admirably precise attack and release, in the Scherzo. And the Finale, as vigorous as anyone could desire yet never stridently forceful, should enliven even the most disgruntled critic.

The sound is first rate in both mono and stereo pressings.

RECOMMENDED

Beethoven—Piano Sonatos No. 21 in C Major, Op. 53 (Waldstein) and No. 30 in E. Major, Op. 109. Rudolf Firkusny. Capitol Mono P8493.

Dvorak — Slavonic Dances Nos. 1-8, Op. 46, and No. 7, Op. 72. London Symphony Orchestra conducted by Jean Martinon. RCA Mono L16274.

Bach — Chromatic Fantasia and Fugue (BWV903); Toccata in D (BWV912); Chorale Prelude "Nun Komm" der Heiden Heiland (BWV659). Haydn—Arietta in A with 12 Variations. Beethoven—32 Variations in C Minor. Mindru Katz (Piano). Pye Mono CCL30143.

Sullivan — The Pirates of Penzance. Richard Lewis, Elsie Morison, James Milligan, Monica Sinclair, John Cameron, Marjorie Thomas, George Baker, Heather Harper, Owen Brannigan. Glyndebourne Festival Chorus and Pro Arte Orchestra conducted by Sir Malcolm Sargent. HMV Stereo OASD381/2. Mono OALP1801/2.

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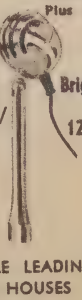

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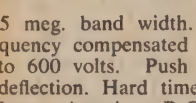

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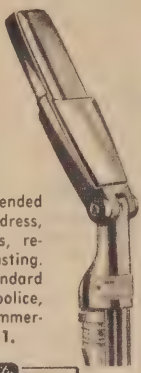

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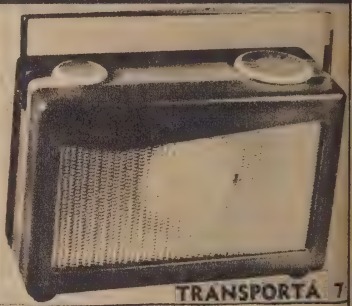

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THE Edison Award presented annually in the U.S. to a radio amateur for outstanding public rvice was awarded this year jointly to John hambers, W6NLZ, and Ralph Thomas, KH6UK, was for their outstanding trans-Pacific experi- ents on 144 Mcs, 222 Mcs and 432 Mcs. These ro amateurs made VHF history since their riginal 144 Mcs contact between Hawaii and alifornia in 1957 by repeating the QSO on the her bands.

Principal speaker during the presentation cere- ony was F. C. C. chairman, Frederick Ford, ho spoke highly of the work of the radio nateurs and referred to them as indisputedly the ue pioneers in the field of radio wave propaga- on. The awards made through the years were wide cross-section of radio amateurs. An dication of the wide field of persons attracted the service can be gained from the profes- ons, etc., of the recipient. They comprised a usinessman, a railway dispatcher, an electronics acher, a blind night school teacher, a food tailer, a Bible student, a house-wife and the cent winners an electronics expert and a com- unications engineer.

COMMISSIONER'S COMMENTS

The Commissioner in his closing remarks made e following observations: It was the efforts these two amateurs that made the most im- ortant amateur radio accomplishment of the ears mentioned possible. Like our original nateur pioneers, Ralph Thomas and John Cham- rs entered the wilderness of radio wave propaga- tion.

Much like the early days when amateurs proved hat long distance communication below 200 etres was possible, John Chambers and alph Thomas established the possibility of com- unication over a distance of more than 2500 iles entirely within the earth's troposphere on 44, 222 and 432 megacycles. We know that this ccomplishment far exceeds any records previously tablished for this mode of radio wave propa- tion and to our knowledge it also greatly ex- eds any known records established by private boratories or government sponsored projects.

On behalf of the F.C.C. I commend Messrs hambers and Thomas for the vision, ingenuity nd perseverence which they applied toward the ccomplishment for which we honour them. It erformances such as this which confirm our elief in the value of the radio amateur of this ountry and makes our task at the Commission ell worth the effort.

N.S.W. DIVISION

ED WHITING, VK2ACD a past president of the N.S.W. Division has been appointed as ouncillor following the resignation of Norm eard VK2ALJ from council. Norm will now con- ntrate on Disposal committee work. Dave Duff K2EO has been appointed Traffic Manager for ie Division to work in the Inter-Division Federal xecutive Traffic net.

Lecturers at May. N.S.W. Divisional Meetings ncluded Bill Storer. VK2EG (ex VK0) who spoke f Antarctica at the mid-month meeting held at dministration Headquarters. Bill who had two ojourns south was well versed on the subject nd displayed some very interesting slides.

Leo McMahon, VK2AC, and Keith Jeffcoat, K2BK were the lecturers at the general meet- g held at Science House, Sydney. Leo pro- ded a wealth of information on a phase of his vourite subject, S.S.B. He covered a phasing ilter type of S.S.B. generator, a system on which e had done much experimental work. Mimeograph heets covering the circuitry were supplied to ssist in a fuller understanding of the subject f the discourse. Keith covered Barium Titanate ilters in the second lecture, a new development the electronics field. Their physical size com- ined with transistors makes possible the build- g of extremely compact IF amplifier units.

Les Jenkins, VK2ZBJ, covered all aspects of HF antennas at the VHF and TV section's May eeting. He provided the latest information of ie various arrays that can be erected for opera- on at these frequencies.

The Newcastle Branch provided a series of lec- rettes on a "How I did it" basis for their lay meeting. The lecturers were Keith Kearines, K2AKC, Stuart Fairbairn, VK2AYF, Stan Lloyd, K2AYL, Les Baber, VK2RJ and Gordon Suther- nd.

Ted Whiting, VK2ACD lectured at the May meeting of the N.S.W. SWL section on S/W Listening and reporting. Ted was for many years short wave correspondent to this and other maga- zines. The information was of great interest to the listeners attending. The section has announc- ed the completion of the first of its reprints of receiver service manuals. The booklet covers the AR7 receiver and is available at a cost of 10/ through the N.S.W. SWL section of the WIA.

MORSE PRACTICE

The N.S.W. Division's Morse Practice is con- ducted nightly on approximately 3525 Kc/s at 1930 hrs. EAST.

The service should be of value to intending amateurs in the Eastern States. The sessions provide the opportunity for any person requiring practice to bring their code standard up to the requirements for the A.O.C.P. Certificate. In- dividual amateurs provide the practice in turn, from their own QTH using the call sign VK2AWI

The session lasts for approximately 45 minutes with morse speeds varying from 5 to 15 words per minute. At the completion of each speed trans- mission the text is read back on telephony. Frank Pearson VK2ACQ is responsible for the arrang- ing of the schedules of transmissions and Harold Burtoft VK2AAH is the Morse session liaison offi- cer with council. Stations providing the practice include VK2AWF, VK2PN. VK2XP, VK2TM, VK2AUC, VK2ANU, VK2AEE, VK2ZK, VK2HC, VK2KQ, VK2LU.

Each Tuesday evening at the completion of the Morse session at 2015 hrs. Doug Courtney, VK2AUC, provides practice for WICEN opera- tors on CW.

VHF SECTION

THE VHF section night fox-hunt in May saw Dick VK2ZCF as the fox, Jim Cuming, VK2PM, was the winner of the event. Keith Laws, VK2ZVL, second and Dave Andrews, VK2AWZ. third. Keith collected the extra point on travelling the shortest distance basis. On a mid-May weekend Paul VK2ZPJ and Graham VK2ZXV braved the cold and operated from the Gib poutside Bowral. They provided 100 watts of input and were rewarded with a contact over a 155 mile path with Hugo VK2WH.

N.S.W. VHF enthusiasts opened up on the 1296 Mc/s band during May for the first time. VK2ZAH, VK2ZAG, VK2ZCF, VK2ZAC, and VK2QW were the early exponents. The first working was a cross band contact be- tween Barry, VK2ZAH, and Dick Norman, VK2ZCF 1296 to 144 Mc/s over a five mile path.

N.Z. ALLOCATIONS

NEW ZEALAND amateur's frequency bands were bought into line with Geneva ITU allocations as from May 1. The main change was on the 7 Mc band where the ZL's had enjoyed greater band widths than the VK's. Their new 7Mc/s allocations are 7000 to 7050 Kc/s CW and 7051 to 7100 Kc/s for telephony. This serious cut will certainly leave the band crammed full of stations. A number of amateurs considers that much of the daylight working on the 7Mc/s band up to 200 miles could just as well be carried out on the 3.5 Mc/s band.

This would leave 7Mc/s clear for longer haul working. 3.5 Mc/s provides excellent signals all the year round for distances up to 150 miles or so, even during summer months. The static level during the period is no worse than 7 Mc/s during the daytime. Greater use of the band would pro- vide an opportunity to appraise its value for shorter haul working during daylight hours.

PROJECT OSCAR

THE ARRL has officially adopted Project OSCAR (discussed April issue). The League has com- mitted its support in the form of facilities for the dissemination of technical and operating in- formation to amateurs throughout the world. The most important aspect is the assurance to the authorities that the project has the backing of the National Amateur Society. The Project OSCAR Association is also a non-profit society of amateurs and among its members many persons pro- fessionally skilled in various phases of earth satellite projects. The OSCAR group in California will still continue the project it has commenced with the co-ordination of the League.

At the present time it is hoped that the first "Orbiting Satellite carrying amateur Radio" (OSCAR 1) will be put in orbit during 1961. Much of the preliminary organisation and requirements are discussed in an article by Russel Garner, K5VPN, and Ralph Wells, K6QMI, in May 1961 "QST."

Amateurs are assured that practically everyone has equipment that will be suitable for hearing and tracking the amateur satellite. The nature of the OSCAR craft has not been decided at this stage, but will possibly follow the low alti- tude polar orbit of the Discoverer satellites. The identification signal to be transmitted will be dis- tinctive and the minimum requirements for recep- tion would be a horizontally polarised multi- element beam and a good converter feeding into a communications receiver. The project will provide plenty of interesting developments for in- terested amateurs. A series of articles in QST will present methods of making observations and recordings of Doppler effect, propagation, slant range and velocity of the satellite, etc

CONTEST DETAILS

THE WIA's Remembrance Day contest for 1961 will be held over the weekend of August 12 and 13. The contest is always the best supported yearly event and amateurs will be busy over the next month making sure their equipment will operate successfully on all bands. The opening ceremony this year will be presented from N.S.W. Full rules and scoring will appear in the August issue.

NATIONAL A.R. WEEK

SOME years ago a scheme was sponsored for the founding of National Amateur Radio Week in the U.S. The earlier bill in Congress died in committee, but New York Congressman William Rhys has again introduced a similar bill. It is to authorise the President to establish and pro- claim a — "National Amateur Radio Week" each year. The idea is that the week would customarily be that culminating in the A.R.R.L. National Field Day.

The bill has been referred to committee and amateurs have been urged to write to Congressmen who are committee members requesting action on the bill in recognition of the amateur's public service.

VICTORIAN ZONE CONVENTION

THE Victorian Division's South Western Zone Convention was held at Warrnambool at the end of May and the office-bearers elected for 1961-62 are as follows:—President, Brian Baulch, VK3XN; vice-presidents, Jim Barber, VK3ABT and Bob Wookey, VK3IC; secretary-treasurer, Don Baulch, VK3AKN; Publicity officer, Eric Giddings, VK3ANQ; auditor, Mrs Giddings. The committee comorises, Brian Alexander, VK3ADV; Bill Dennis VK3XE; Don Daniels, VK3ADJ; Chris Cullinan, VK3AXU; Brian Stares VK3ZBS and Dick Heigh- way, VK3ABK.

During the convention, the Zone's WICEN operators who conduct their own organisation elected their officers. They were zone co-ordinator Pat Lang, VK3ADN, and Deputy co-ordinators VK3AKN and VK3ABT. The three will form the committee for the management of Wicen. Visitors to the convention were Michael Owen, VK3ZEO, State secretary, representing the Victorian Divi- sion, Michael VK3ZEO, Luke VK5LL, Ron VK3ZER, David VK5AW, Ron VK3ZFM and other travellers.

A series of field events was conducted and these are the winners: 80 metre Hunt (Transmitter hidden by Brian VK3XN. First, Michael VK3ZEO and second John VK3AGD. John won the Geel- ong Amateur Radio Club's Perpetual Trophy which is available to members of the zone or affiliated clubs participating in the event.

144 Mc/s Hunt (Transmitter hidden by Bill VK3ZFG and Kevin VK3AKR): First again was Michael VK3ZEO. The all-band scramble was won by Don VK3AKN and the award for the best mobile to John VK3AGD. 80-metre Fox Hunt was won by Michael VK3ZEO and second place in this event had to go to the Fox VK3AKN who arrived home without being caught; he was aided by co-pilot John VK3ARJ who was on his home ground.

All the Ladies drew a prize for the best lunch ever and many other novelty events were also conducted.

Band conditions in the zone have fallen off on 40 metres and especially with the additional QRM from more B/c stations, main activity has been centred on 3.5 Mc/s. More stations are coming up on 144 Mc/s in the western part of the State and in south-eastern portion of South Australia.

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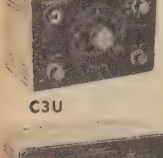
TEST EQUIPMENT



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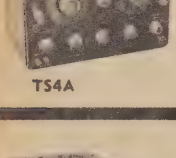
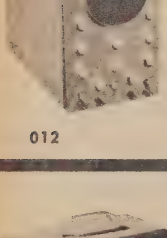
Measures capacity, 10pF to 1,000uF. Resistance 100Ω to 5MΩPwr. Factor. Weight 7lb **Price £23.**



TS4A

HEATHKIT TV Alignment Generator Kit (TS4A).

When used with oscilloscope gives you all essential facilities required for alignment of FM TV. 5.5 mc crystal marker provided. Input 110 VAC, 50/60 cps. 50 watts. Weight 16lb. **Price £55/6/-.**



O12

HEATHKIT Extra Duty 5in Oscilloscope Kit (0-12).

"Y" Sensitivity 10 mV/cm. 3 c/s to 5 m/c. Rise time 0.08 u sec. Sweep 10 c/s to 500 K c/s. Input 240 VAC. 50 cps. Weight 22lb. **Price £94/8/-.**

HEATHKIT DIRECT READING CAPACITANCE METER MODEL (CM-1U):

Full-scale ranges of 100 micro-microfarad, 1,000 micro-microfarad, 0.01 microfarad and 0.1 microfarad. Easily built in a few hours.

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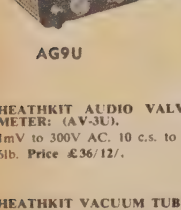

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HEATHKIT AUDIO GENERATOR: AG-9U.

10 volts, 10 c/s to 100 kc/s pure sine-wave. Switch-selected frequencies / attentuation. Weight 10lb. **Price £50/1/-.**

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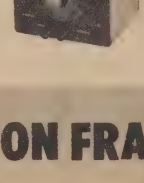
"Y" sensitivity 0.09V/inch. 4 cps to 1.2 M c/s. Rise time 0.25 microseconds. Sweep 20 cps to 150 kc. Input 105-125 VAC 50/60 cps. 65 watts. Weight 22lb. **Price £44/12/-**

HEATHKIT AUDIO VALVE-MILLIVOLTMETER: (AV-3U).

1mV to 300V AC. 10 c.s. to 400k c/s. Weight 6lb. **Price £36/12/.**



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HEATHKIT VACUUM TUBE VOLTMETER (V7A):

The world's largest-selling VTVM. Measures Volts to 1,500 (DC and RMS) and 4,000 pk. to pk.; Resistance 0.1 ohms to 1,000M ohms DC. Sensitivity 7,333,333 ohms per volt. Weight 17lb. **Price £32/8/.**

STEREO EQUIPMENT

HEATHKIT HI-FI STEREO 16 WATT AMPLIFIER (S-88)

Superb reproduction for the man who wants the best in HI-FI. Only 0.1 per cent distortion at 6 w/chnl. Many special features.

Price £72/2/-.

S88

HEATHKIT HI-FI RATED 14/14 WATT STEREO AMPLIFIER KIT (SA2)

Delivers full 14 watts per stereo channel (28 watts monophonic) to drive your most demanding stereo system with ease. Weight 23lb.

Price £66/10/-.

SA2

HEATHKIT HI-FI FM TUNER (FM4)

Range 88-108 M c/s. Quieting Sensitivity 2.5 uv for 2 db. Harmonic Distortion less than 1 per cent. Frequency Response plus minus 2 db 20-20,000 cps.

Price £36/12/-.

FM4

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HEATHKIT "APACHE" HAM TRANSMITTER KIT (TX1) combines quality, versatility, style and low cost.

- Provision for single sideband Adapter.
- "Spotting" Push button for "Zero beat."
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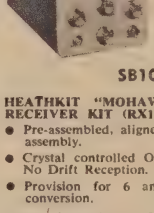
Offers 150 watt Phone and 180 cw input operation. **Price £269.**

TX-1



SB10

HEATHKIT SINGLE SIDEBAND ADAPTER KIT (SB-10): Covers 80, 40, 20, 15 and 10 metre bands. The adapter produces either USB, LSB or DSB signals with or without carrier insertion. **Price £100/16/9.**

HEATHKIT BALUN COIL KIT (B-1): Match in balance of coaxial lines with this convenient transmitter accessory. Weight 5½lb. **Price £10/1/.**

HEATHKIT CW TRANSMITTER KIT (DX-20):

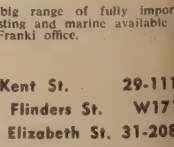
- Best watts for £ value.
- Clear Signal.
- Single Knob Bandswitching.

Covers 80-10 metres using crystal or an external VFO. Weight 18lb. **Price £40/6/.**

HEATHKIT "MOHAWK" HAM RECEIVER KIT (RX1).

- Pre-assembled, aligned front end assembly.
- Crystal controlled Oscillator for No Drift Reception.
- Provision for 6 and 2 metre conversion.

Similar in styling to TX1. Covers all bands, 160 through 10 metres. **Price £310/5/.**



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CB TVI PROBLEM

PROBLEM facing U.S. amateurs, and not directly their particular worry, is the appearance of a considerable amount of TVI caused stations operating in the 27 Mc Citizens' Band. any amateurs know from bitter experience that ey are often blamed for the unusual that pears on the TV screen or for that matter ard on a B.C. receiver. This TV interference particularly troublesome in the closely settled eas. It is appreciated that most Citizen Band erators are not technically competent and it uld appear that amateurs could assist in minating the interference.

It has been suggested that Citizen Band users uld be asked to join local TVI groups so they uld be informed on the requirements for suppssion of the TVI. In the interests of the Amar Service, despite the fact that amateurs have moral obligation to cure such interference, m a public relations aspect action along the posed lines would be a good investment.

MARITIME MOBILE

URRENTLY being considered by the F.C.C. is a rule that will permit worldwide operan of U.S. Maritime Mobile Amateur on the Mc bands.

At present this privilege is only available to se operators while located in ITU Region II; ewhere they can only operate 21 and 28 Mc. her matters under consideration include the ension of conditional-class licences to cover ilians overseas, regardless of the distance of ir permanent home, from an F.C.C. examining int. The examination for this class of licence, e the Novice Class, can be conducted on behalf the F.C.C. by other amateurs.

MOBILE OPERATION

OME comment has appeared in overseas journals on the subject of Mobile Operation on the ve. A number of amateurs have expressed tions that such Mobile Operation should be ed out except in an emergency. They consider t drivers should give their undivided attention the road and not be concerned with the signal ength at some distant spot. Actually it was taski, KH6IJ's Mobile SW Operation that sparkthe subject off when he claimed good CW tacts travelling 70 m.p.h. One amateur pressed the opinion that he would rather be on road with Nosey sending CW and travelling 70 m.p.h. than with some 18-year-old with ir arms around a girl at 25 m.p.h. Nosey renowned for his CW; he was rather doubtful out the youngster's concentration.

TRAINING CAMP

HE Y.M.C.A. in North Carolina ran earlier in the year an interesting camp for would-be ateurs. Carl Peters, K4DNJ, the originator of idea, firmly believed that many beginners in io would like to join a camp where morse and hnical radio instruction would be provided. The)-week course attracted some 35 students from brackets of 11 to 65 and they were all after ir general class licences.

Many of them were holding Novice and Techni- Class licences but, after the two weeks' conious tuition, the students had no problems with 13 words per minute requirement or the technal examination. Some of the pupils were up a 20 w.p.m level by the end of the period. The .C. provided an examiner who journeyed to camp to conduct the tests. The camp was so cessful that many applications are already in id for the next class camp to be run at Christ- s.

AMATEUR FOUNDATION

SEVENTEEN Radio Clubs in the Washington-Baltimore Area, U.S.A. have joined together a project known as the Foundation for Amateur dio, Inc. The Foundation has announced the in Gore Memorial Scholarship available to a dio Amateur for either graduate or undergradu- study.

he scholarship pays 250 dollars for the academic year and is subject to renewal. John W. Gore, W3PRL, in whose honour the scholarship was named, was a prominent Baltimore amateur.

SSB POPULAR

THE SSB mode of making an impression on the amateur bands is becoming more popular each month and the annual survey conducted by the A.R.R.L. shows quite an upward curve during 1960. The survey is made among a random group of amateur radio clubs and on the last occasion covered some 2291 licensed amateurs. The figures quoted are the percentage of licensees using SSB and cover the past five years 1956 — 5.0, 1957 — 5.95, 1958 — 6.36, 1959 — 10.7, and 1960 — 17.00.

REASON FOR MOBILE?

AN interesting story contributed by W6WFR and published in QST covered a side-line of Mobile Operation. The XYL had taken the car out complete with 7 Mcs whip and was involved in a minor accident. The driver of the other car was just ready to hold forth on the subject of women drivers and the like when a small voice was heard from the said gentleman's vehicle, "Daddy, that's a policeman's car;" complete silence from then onwards.

That is one excuse for the attaching of a whip to the family car.

"GENTLEMAN'S AGREEMENT"

WITH the waning sunspot maxima DX conditions on the 3.5 and 7.0 Mcs bands are improving rapidly. CW operators would appreciate the leaving of the low frequency end of the bands free of telephony for their use. The "gentleman's agreement" on this point, sponsored some time ago, worked very effectively for many years, but seems to be forgotten these days. In view of the percentage increase in AM and SSB operation in recent years, the 50 Kcs left clear in this agreement would need some amendment. Most amateurs find it difficult to find a clear spot for any mode of transmission, especially on 7 Mcs.

It is a pity to see CW and telephony clashing. There are enough problems with QRM without this happening. CW still has many supporters on these two bands and a clear space would be appreciated during the evenings and early mornings when the unusual prefixes are about. Possibly a re-examination of the said agreement at this stage would be an excellent idea in view of the anticipated general exodus to the lower frequency bands.

EXPERIMENT MOHOLE

(Continued from Page 9)

the tremendous run of pipe would have snapped like a twig. Work was continuous through all but the worst weather. Gale winds would have demanded recovery of the entire column, a labour of eight to 10 hours.

Weight on the bit and speed of rotation — normally 40 r.p.m. — was controlled as delicately as a jeweller controls his drill.

The final site for act three, Lill said, will be in the Guadalupe area, in equally deep water off Puerto Rico, or in some other locality not yet chosen. More than five years of research and seismographic testing preceded the warm-up drilling.

"Hot spots" on the ocean floor are one of the many hazards, the scientist said. Radioactivity can shoot the normal temperature of four degrees Centigrade on the ocean floor up to more than 180 degrees Centigrade at the base of the crust.

"Then the diamonds in the bit come loose and the electronic gear goes crazy."

Reason for drilling beneath deep water is that the earth's crust is believed to be thinnest under the oceans — about five miles thick as against 25 miles under the continents.

Lill was connected with research drill projects on the Marshall Islands, following the first atom-bomb tests, and later at Eniwetok. At Lockheed he is senior scientific adviser to the development planning board at corporate headquarters, Burbank.

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Amateur — from £3/-/- each plus 12½ per cent sales tax.
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SIZE: 1½inch Front O.D. to
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7⅛ inches Long.
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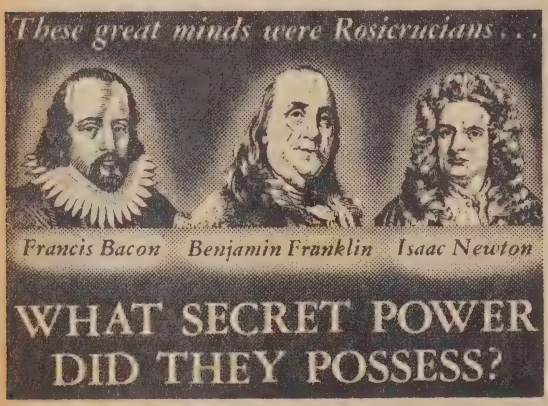

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ON SHORTWAVE — By ART CUSHEN

Ecuadorian Government Station

A new voice from Ecuador "Radio Emisora National Ecuador" has been heard with test broadcasts prior to regular operation.

THE new station, which is the first official radio in Equador to be operated by the Government has been testing on 4940 Kc with 10,000 watts. In the past, HCJB has carried all State announcements. According to the announcement in Spanish, the station was to commence regular operations in late May, and would carry the broadcasts on 640 Kc. medium wave and 4940 Kc. shortwave, both with 10,000 watts.

Programmes of relays from the National Theatre, sports, news and music were listed as scheduled for broadcast. The station asked for reports to a box number in Quito, while a telephone number was also listed during the official test periods. The tests were heard to after 0800, but best reception should be in the late evenings in this area. At 1115 we have heard broadcasts for the day commencing with strong signals.

OAX7A ON 6230 Kc.

THE reception of a little-heard Peruvian station, OAX7A, using the new frequency of 6230 Kc. has been heard to sign off at 505 G.M.T. on Sundays. This 2500 watt transmitter is assigned 5128 Kc., but was heard on 6230 Kc. with frequency identical to "Radio Cuzco." Latin American music was heard to 0500, then frequency reference to station call and slogan before transmission ended with a Latin American sign off number. OAX7A is using 1470 Kc. on the broadcast band, as well as the new short-wave frequency. Cuzco in Peru is a large province in the Bolivian border and occupies the eastern slopes of the Andes. On an altitude of 11,400 feet, it is one of the highest stations in South America. The city has a population of 45,000 and is at the head of the Amazon River.

VL2UV ON 1750 Kc.

THE opening of the University of New South Wales transmitter on 1750Kc. has been reported from both sides of the Tasman. This unique station carries lectures to post-graduates and is on the air from 0930 to 1030 on Wednesday and Thursday. The station uses 300 watts and a T. anteana. Prof. Derek Broadbent, Co-ordinator of Post-Graduate and extension studies, advises that the station also sends out test signals each afternoon between 0400 and 0700GMT. He would be most grateful to receive reception reports, and will certainly acknowledge them; return postage would not be required. Reception has been good in this area and our thanks to Adrian Peterson, Adelaide, Mr. Hallett, Enfie'd, and Stephen Thurlow, Cabramatta, N.S.W. for information on this station and its official openings, which enabled our reception.

AFRICAN SIGNALS

SOME interesting signals from the African continent can be heard in the next two months before dawn, and Denis Parks H.M.A.S. Lonsdale Melbourne supplies a list of some of the signals he has been hearing on the low frequency bands of 3 and 4 megacycles.

3288 Tananarive, general French program 1630.
3301 CR7AB Lourenco Marques Portuguese program 1850 G.M.T.
3316 SABC Johannesburg at 1720.
3335 Port Louis, Maritius, Popular French and English programs 1630.
3380 St Denis Reunion French programs 1625.
4797 Radio Somali, B.B.C. news at 1800 then local news.
4810 SABC Johannesburg English news 1700.
4911 Lusaka Local news at 1810.
4915 Accra, news at 2100 G.M.T.

NIGERIA ON 4855 Kc.

AIRMAIL verification has been received from the Eastern Nigerian Broadcasting Co. Ltd., which has been heard on 4855 Kc. in the afternoons in this area. The station is on the air on Sunday 0600-0800GMT, 1530-2230, weekdays 0500-0800, 1530-2300 all on 4835 Kc. The Eastern Nigerian Broadcasting Ltd., is the operating company and the address is P.O. Box 350, Engru, Nigeria.

HCRP1 USES 5010 Kc.

GOOD signals from a seldom reported Ecuadorian station have been heard, when the station HCRP1 opens at 1030GMT. Opening is with a march and a program of military band music continues to 1045, when the station announcer identifies the broadcast, News and other local items follow, and at 11.00 a religious broadcast commences. The station has the power of 1Kw. and the address is Cuenca 927, Quito. The station uses the slogan "Radio Catholica," which is frequently given during the opening announcement.

READERS' REPORT

IN a variety of letters received from our readers each month, one from from Master Stewart Brown of Melbourne, Vic., is worthy of publication, as he is full of praise for the Short Wave Notes, which gives him such a help with his hobby. Master Brown says in part, "Thanks for your informative articles—keep it up—as they are so much appreciated." He reports the reception of many signals and remarks of the fine signals and programs he receives from Radio New Zealand. The DX Session by the way is now at 06.40 and 10.30G.M.T. on 11780 and 6080 Kc, on the first Wednesday of each month.

NEW SCHEDULES FROM BERNE

The latest schedule from the Swiss Shortwave Service from Berne is now carried on the new schedule which is broadcast as follow:

Area	Times	Call signs
Europe	0545-0645, 1100-1230	HER3 HER4
	1500-2245	
Africa	0545-0645	HEI5
	1000-1100	HER8
	1445-1630	HEU7
	1700-2245	HEI5
Australia, New Zealand	0715-0945	HEI9 HEU6 HER5
Japan and S.E. Asia	1245-1430	HEU7 HEU6 HER5
India, Pakistan	1445-1530	HER8 HEU6 HER5
Middle East	1645-1830	HEU6 HER5 HEU3
United Kingdom, Ireland	1845-2030	HEI3 HED5
Spain and Portugal	2045-2230	HER4 HER5
South America	2300-0045	HER3 HER4 HER5
South America	0230-0400	HER3 HER4 HER5
North America	0130-0315, 0415-0500	HER3 HER4 HER5

The frequencies used are HED5, 9545. HEI3 7210, HEI5 11795, HEI8 17795, HEI9 21605, HER3 6165, HER4 9535, HER5 11865, HER8 21520, HEU3 9665, HEU6 15315, HEU7 17720 Kc.

FLASHES FROM EVERYWHERE

CHILEAN station CE970 is being received at good strength at 2300G.M.T. according to one of our readers, Denis Parkes, of H.M.A.S. Lonsdale, Melbourne. The station is easily recognised at 2300, when they play the interval signals of some notes from "Land of Hope and Glory." CE970 operates on 9700Kc., and the program, after opening, includes music of both Latin American and popular varieties.

BUCHAREST in Roumania is being heard on several new frequencies in the service to North America from 0430 to 0500 G.M.T. This session in English is on 15380, 11940, 11810, 9590, 9570, 9510, and 6190Kc. Signals are best in this area on the new 15380Kc which is free from any interference and all the other channels being subject to interference of some degree.

LEOPOLDVILLE is carrying a service to North American listeners on 11755 Kc., and has recently re-timed the news bulletin in English. This is now broadcast at 0145 instead of the former 0045 G.M.T. The complete transmission is 0030 to 0230 and uses 11755 Kc.

SANTA ISABEL, which has been heard in the afternoons, now has a news bulletin in English. The session is 1830 to 1900 and the station uses 6240 Kc. with 5Kw. power.

JORDAN with the service to America is using two frequencies for the 100Kw. transmitter of the Hashemite Broadcasting Service. In this area the English program on 7155 Kc. has been heard to sign-off at 0315 G.M.T. The service to South America, in Arabic, Spanish and Portuguese is on from 2300 to 0100, on 15170 Kc., and from 0115 to 0315 G.M.T. Announcement is "This is Amman, the Hashemite Kingdom of Jordan."

DJAKARTA, in Indonesia, which has a service to Europe from 1615 to 2000 G.M.T., is now using 9865 and 11710 Kc. The last hour of the transmission is in English, and is also scheduled as beamed to New Zealand for this period. The 9865 Kc. channel has replaced the former 9585 Kc. frequency.

DAKAR in Senegal, has a transmission of half-hour duration, on Tuesday and Saturday from 1730 to 1800 G.M.T., using 15115 Kc. The program includes news in English, French and German.

NIGER, in Africa, has been reported from the U.S. at good level on 4785 Kc, from 0530 G.M.T. The station carries news in French at 0615. Radio Mali at Bamako, Mali Republic is using 7145 Kc. and has been noted from 0630 to 0800 on 7145 Kc.

BANGKOK, with the broadcasts of Radio Thailand, using 7230 Kc., has been heard from 1030 to 1530 G.M.T. Programs are entirely different from those on 7300 Kc., and reception of the new channel is marred by Soviet, Korea, using the same frequency, according to a Japanese report.

PHILIPPINES station DZI9, of the Far East Broadcasting Company, has dropped from 7250 to 7240 Kc. The station is on the air from 1600 to 1705 G.M.T., with programs in Russian on Sundays and in Chinese on other days.

COSTA RICAN station TIPGH, which is assigned 6115 Kc. has been heard in Europe at 0300, when using the new frequency of 6230 Kc.

LIBERIAN station ELWA in Monrovia has opened a new 90-metre outlet. This station has been heard in the United States on 3225 Kc. and uses the power of 700 watts. The station relays the medium-wave program around 1600 G.M.T

Notes from readers should be sent to Arthur Cashen, 212 Earn Street, Invercargill, N.Z. All times are GMT (Greenwich Mean Time). Add 8 hours for West Australia, 10 hours for Eastern Australia and 12 hours for New Zealand and Fiji.

BREMEN in Germany is reported to have commenced a short wave service, and is being heard on 6195 Kc. The station has been noted at 1700 G.M.T., but, in this area, we should enjoy best reception in the period 0600-0700 G.M.T. A new West Berlin station is also planning to open a transmission in the 49-metre band using the power of 1 to 2 Kw.

CAIRO with broadcasts from the United Arab Republic and this new service to West Africa is carried on 17690 Kc. From 2030 G.M.T. local dialects are transmitted and at 2130 a programme in English is released. The European service from Cairo is still heard on 11915 Kc, and heard with English on this frequency also at 2130 G.M.T.

VATICAN RADIO with its news bulletin in English from 1815 to 1830, has made some frequency changes, and this is now carried on 15120, 11745, 9645 Kc. An earlier session is from 1500 to 1515 G.M.T.

COLOGNE has made some frequency alterations, being necessitated by a new frequency plan, which is now being used by short wave broadcasters to allow more efficient use of the available channels. The Deutche Welle signals to Japan are now carried on 21705 Kc instead of 21735 Kc for the period 0945-1245 G.M.T. The second program to South America 2030-2200 G.M.T., is now on 15405 Kc instead of 15370 Kc.

MONACO, home of the Transworld radio,supplies news of its latest schedule of the broadcasts from Monte Carlo: 1535-1600 (German) on 7155; 1605-1635 (Russian) 11705 Kc; 1640-1725 (German) 6115 Kc; 1730-1755 (Norwegian) 9705 Kc; 1755-1825 (Swedish) 9705 Kc; 1825 to 2000 (English) 6115 Kc; 2000-2025 (German) on 6115 Kc. A Dutch transmission is broadcast 2025-2040, on 6.15 Kc; 2045-2100 (Arabic) on 11805 Kc. Further tests are being made to Eastern Europe, Spain and Portugal after 2100 G.M.T. A further transmission in English on 9705 Kc is now on the air from 0700 to 0900, being an extension of the old 0730-0830 program.

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No. 710, 5 piece set 10/6
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..	5/	6K7 ..	3/11	27 ..	10/6
..	3/9	6K8 ..	6/9	37 ..	10/6
..	7/6	6L7 ..	3/11	85	10/6
..	3/6	6N7 ..	9/6	117N7	7/6
5/	5/	6Q7 ..	12/6	100TH	9/6
..	7/6	6R7	12/6	217C	10/
..	1/6	6SC7	12/6	615	10/6
..	3/9	6SF5	7/6	705A	15/
..	12/6	6SH7	2/3	801	12/6
..	15/	6SJ7	12/6	802	25/
..	3/11	6SR7	12/6	803	40/
..	4/6	6SN7	12/6	804	35/
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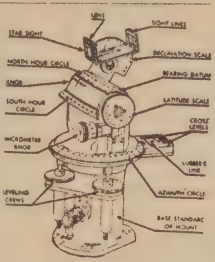

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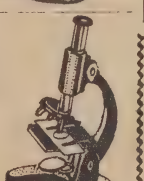

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Dimensions: (3½" x 5¼" x 1¾")
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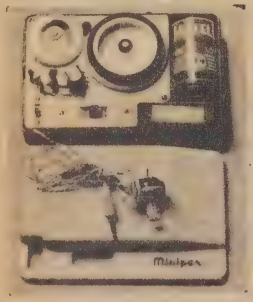

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Complete with earphone and Mike combined
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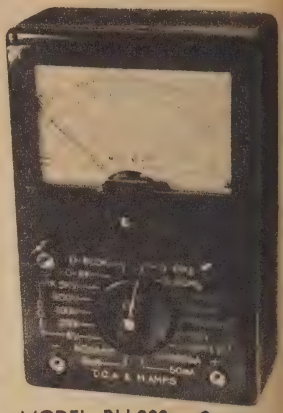

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DC Current: 0-50 uA, 0-5-50-500mA
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DC Current: 0-50, Microampe res. 0-25, 0-250 Milliamperes
Resistance: 0-60K Ohms, 0-6Meg Ohms
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ANSWERS TO CORRESPONDENTS

SOUND FOR 8mm. PROJECTORS?

:.D. (Charters Towers, Qld.) sends us iils of the interference problems which has encountered in his district, and s that there is much field for research this problem. He also suggests that should consider a constructional :le on adapting existing 8mm movie iectors for the magnetic stripe sound em.

..: We agree, C.D., that there is conrable work yet to be done in the t of interference prevention and supsion. Meanwhile, we would suggest you try to obtain the book entitled minating Man-Made Interference," by Darr, published by Howard H. Sams Co. Inc., of Indianapolis, New York, N.Y. This book should prove very helpful in such situations. Refer also to our Anti-Noise aerial of July, 1953.

Regarding the 8mm sound stripe position, we have been considering this scheme for some time. At present, however, the position regarding quality of the available magnetic stripe and the availability of mechanical parts is not clear. This makes immediate action impracticable as far as the magazine is concerned.

However, we are keeping in touch with current developments in this field, and will certainly present details of a unit as soon as we feel the situation is clearer.

.J. (W. Perth, W.A.) asks why we the high tension power from the nent of a rectifier valve, when the e of most valves is the electrode con- ed with the HT line.

.: Well, F.J., the answer lies in the they do. Most valves in circuits are nected between the HT line and h, and dissipate power while per- ning their function as an amplifier scillator, etc. Rectifier diodes, how- , are used as an "electronic switch." h connects the HT line to the AC ly only when the supply is positive. different job accounts for the dif- nt connection.

nother way to look at it is by con- ing electron flow. For a current to in any circuit in a continuous ner, there must be a continuous for electrons to follow. As you ibly know, in normal valve stages electrons travel from the cathode, at oximately earth potential, to the via thermionic emission. To com- the continuous path back to earth, must be a path through the recti- valve and the transformer of the AC ly. Since electrons can only travel normal valve from cathode to plate, obviously means that the rectifier be connected with its cathode to HT line (and the plates of the other s), and its plate to the AC supply.

★ ★ ★

A.R. (S. Richmond, S.A.) sends us ircuit for a small amplifier for use a crystal microphone, and asks if ould suggest some improvements to

: Well, J.A.R., the circuit is basic- O.K., but there are a few points h we might comment upon. Firstly, nput circuit could be improved by ving the 2.2 meg resistor and 400 apacitor completely. These merely e the input impedance without ciably altering the tone.

xt, the 200 pF capacitor can be ved from the voice coil circuit, as ll have no effect to this low impe- e signal.

ally, if treble cut is desired, you try shunting the 10K series resis- the feedback line with a capacitor. lue of about 0.01 mfd would be a start.

e circuit as it stands actually has icient gain to operate a microphone correctly. Thus, if greater volume is desired, we would advise the addition of another valve, such as another 6AU6 or an EF86. As a guide, the circuit we published for the "GP Junior Amplifier" of October, 1954, may prove helpful.

★ ★ ★

N.J.S. (Parkdale, Vic.) sends us the circuit and details of a three transistor audio amplifier, suitable for crystal set amplification and battery players. He hopes that we find it suitable for inclusion in the "Reader Built It" section of the magazine at some future date. He also asks if we can diagnose the faults of an old dual-wave receiver he has been restoring.

A.: Thanks for the circuit, N.J.S., which we will file for possible inclusion in the Reader Built It section. As for the set, the crowding of the broadcast stations is probably due to lack of correct alignment and correct oscillator tracking. The padder capacitor may even be shorted. The sudden loss in volume on warming up is possibly due to a gassy valve—the 42 would be a good place to check first. Thanks for your kind words regarding the magazine.

★ ★ ★

K.B.L. (of Christchurch, N.Z.) asks about the suitability of an Oscilloscope for television alignment and also says that he would like to see the description of an amateur receiver capable of receiving both A.M. and S.S.B.

A.: Almost any Oscilloscope could be used for television alignment with a frequency modulater generator, since the requirements in terms of a frequency response are very modest. So far as screen size is concerned, a 5in type is very convenient, but perfectly satisfactory results can be obtained with a 3-inch tube or even somewhat smaller if the trace can be focused finely. We are planning to embark on a whole series of projects of interest to Australian and New Zealand amateurs and it is quite likely that a receiver circuit along the lines you suggest will be forthcoming in due course.

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(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

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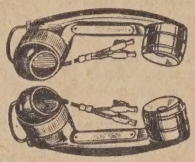

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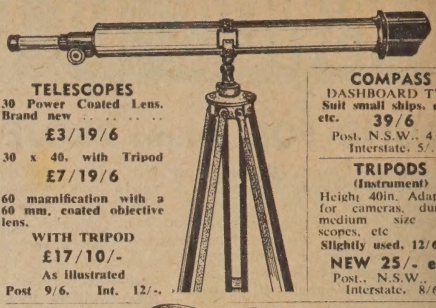

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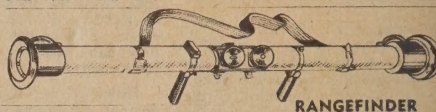

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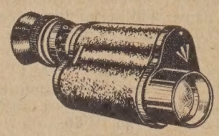

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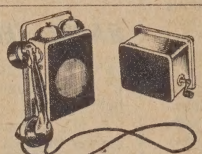

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HEMISTRY—A STORY OF CARBON

(Continued from page 14)

n. So we start with a "monomer" finish up with a long chained mole- called a "polymer." A similar action place with other substances such he chemical "styrene" which will merise" into 'polystyrene."

ow, as mentioned earlier, carbon s sometimes link themselves to s other than hydrogen, oxygen and gen. Suppose it links with chlorine. again at the picture for methane. ace the hydrogen atoms with ine and we have a picture for that cleaning fluid called 'carbon tetra- ide." This is a non inflammable l quite potent as a cleaning agent.

AESTHETICS

ow let us replace only three of the ogen atoms in methane with ine atoms leaving one hydrogen . This gives a picture of chloro- which was a popular anaesthetic ie time.

you look at the picture showing the cule of "benzol" it will be seen to st of six carbon atoms linked to ydrogen atoms in the form of a ring. benzol can by no measure be in- d in the list as an anaesthetic. Yet ave only to rob benzol of three car- atoms and we get the powerful thetic called "cyclopropane," which eplaced ether and chloroform to a extent. The picture of cyclopro- " is shown for comparison (Fig. 6).

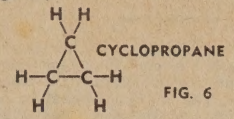
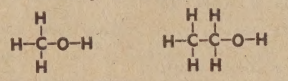


FIG. 6

Generally speaking any compound which has its molecules in the form of rings is called a cyclic compound while those without rings are called "acyclic" compounds.

Look again at the picture of methane gas. Now move one hydrogen atom over to the right and push in an atom of oxygen. We now have "methyl alcohol" (Fig. 7a) which unlike methane is a liquid and again unlike methane will dissolve in water. Methyl alcohol is very useful in industry as a solvent.



(a) METHYL ALCOHOL (b) ETHEL ALCOHOL

FIG. 7.

Now take the methyl alcohol picture and shove in two more hydrogen atoms and one more carbon atom in the positions shown. We now have a picture of a more interesting molecule, "ethyl alcohol" (Fig. 7b).

This is THE alcohol which is used as a stimulant in beverages too numerous to mention.

(One of the best known examples of these two alcohols is "methylated spirit." Basically this is ethyl alcohol, an almost tasteless and odourless liquid which is extremely potent if one should be foolish enough to drink it "as is."

However, since it has many valuable industrial applications, it is convenient to be able to use large quantities without the risk that it will be misused as a "beverage." For this reason there is normally added a small quantity of methyl alcohol — hence the "methylated" — which is extremely unpalatable. The result is a very valuable industrial liquid, safe from the attention of unduly thirsty types.)

It will thus be seen that the compounds of carbon play a very important role in life. There appears to be no end to the compounds which the chemist can make. In that sphere the chemist is always guided by the types of picture or structural formula shown throughout this article. He builds up his own picture.

By means of these pictures he is now able to choose the spots in a chain of molecules which can be broken into smaller and simpler chains. He can rearrange the molecules into chains or rings. He knows in advance what the result is going to be.

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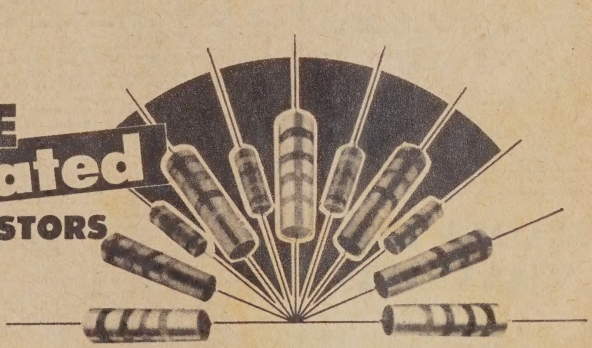

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